



CARPET STORE FIRE

Branford, CT

November 28, 1996



FIRE INVESTIGATIONS

NATIONAL FIRE PROTECTION ASSOCIATION

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FIRE INVESTIGATION REPORT

**Carpet Store Fire
One Fire Fighter Fatality
Branford, CT
November 28, 1996**

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ABSTRACT

At approximately 4:24 p.m. on Thursday, November 28, 1996, a fire occurred in a Branford, Connecticut, carpet store and warehouse. The fire started in the store's office area, damaged the ceiling assembly, and ignited the building's wood roof trusses. Seven fire fighters were making the initial attack when the roof collapsed. Five of the seven fire fighters were able to find their way out of the building. The sixth fire fighter was rendered unconscious and had to be rescued, and the seventh died before he could escape.

The building was 60 ft (18 m) wide and 120 ft (36.5 m) long. It had wood-frame exterior bearing walls in one section and masonry block exterior bearing walls in all other areas. Lightweight wood trusses carried the store's roof over a clear span of 60 ft (18 m). The building did not have any fire detection or suppression systems.

On arrival, the Branford fire fighters, responding to a report of smoke coming from the roof of a carpet store, found light smoke showing near the roof eaves at the front of the building. On the basis of the observed conditions, the fire officers believed that the fire was located somewhere in the showroom area. Before the six fire fighters began to advance the two hoselines into the building, a seventh Branford fire fighter joined them without the knowledge of the incident commander.

The fire fighters found fire in a corner of a showroom and attempted to extinguish it. The incident commander who was outside of the building and the interior officer realized, at about the same time, that there was fire above the fire fighters. The interior officer ordered everyone out of the building, and the incident commander also radioed the interior crews, ordering them out. Before the fire fighters could leave the building, the roof collapsed. This was approximately 17 minutes after the fire fighters arrived on the scene.

One fire fighter had left the building just moments before the collapse and three fire fighters escaped out of the front of the building. The officer and two fire fighters were trapped toward the center of the building. These fire fighters freed themselves from the debris and began spraying the burning rubble with a hoseline. The officer then told the two fire fighters that they would have to move to the rear of the building where two overhead doors were located. The officer and one fire fighter began moving toward the rear of the building and became separated from the other fire fighter.

Before reaching the door, the fire fighter who was with the officer ran out of air and collapsed. Unable to help the fire fighter, the officer continued on, found a door and left the building. Once outside, the officer could not locate any personnel to assist him, so he reentered the building. The fire officer found the collapsed fire fighter even though the fire fighter had not turned on his PASS (Personal Alert Safety System) device. The officer dragged the fire fighter out of the building.

Once the incident commander learned that six fire fighters had escaped, he believed

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that everyone was out because he was not aware that a seventh fire fighter had entered the building. After a brief discussion of the events that had occurred, the officers determined that one fire fighter had, in fact, not escaped. The missing fire fighter was found approximately 20 ft (6 m) from the position where he was last seen by the interior officer. The cause of the fire fighter's death was listed as smoke inhalation.

On the basis of its investigation and analysis, the NFPA determined that all fire fighters who entered the building were at risk of being trapped and killed. The following significant factors directly contributed to the danger that threatened everyone in the building and to the loss of the Branford fire fighter:

- The lack of automatic sprinkler protection
- The lack of pre-fire plan or other information that would have made fire officers aware that the roof of the store was constructed with lightweight wood trusses.
- Ineffective communication during verbal exchanges on the fireground.

In addition, the following factors detracted from potential for rescuing the fire fighters who were trapped in the building and decreased the efficiency of fire-ground operations:

- Ineffective use of an incident management system and no formal fire fighter accountability system
- The absence of a Rapid Intervention Crew (RIC) and the absence of a fire department standard operation procedure requiring a RIC
- The lack of a dedicated fireground channel
- Ineffective communication while using radios.

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I. INTRODUCTION

At the request of the Branford, Connecticut, Fire Department, the National Fire Protection Association (NFPA) investigated the Branford carpet store fire. NFPA has a long-standing fire investigations program. Under this program, NFPA documents incident facts and analyzes significant factors that result in the loss of life and property.

The study was conducted by the NFPA as part of its on-going program to investigate technically significant incidents. The NFPA's Fire Investigations Department documents and analyzes incident details so that it may report lessons learned for life safety and property loss prevention purposes.

The NFPA became aware of the Branford fire the day after it occurred, and Stephen N. Foley, Senior Fire Service Specialist in the NFPA's Public Fire Protection Division, traveled to Branford, Connecticut, for an initial one-day on-site study of this incident. Several days later, Foley and Michael S. Isner, Senior Fire Investigator in the NFPA's Fire Investigations Department, returned to Branford for two additional days of on-site work. The information gathered during the on-site activities and the subsequent analysis of that information were the basis for this report. Entry to the fire scene and data collection activities were made possible through the cooperation of the Branford Fire Department and the Connecticut State Fire Marshal's Office.

This report is another of the NFPA's studies of fires having particularly important educational or technical interest. All information and details regarding fire safety conditions are based on the best available data and observations made during the on-site data collection phase and on any additional information provided during the report development process. It is not the NFPA's intention that this report pass judgment on, or fix liability for, the loss of life and property resulting from the Branford fire. Rather, the NFPA intends that its report present the findings of the NFPA data collection and analysis effort and highlight factors that contributed to the loss of life and property.

Current NFPA codes and standards were used as criteria for this analysis so that conditions at the carpet store on the day of the fire could be compared with state-of-the-art fire protection practices. It is recognized, however, that these codes and standards may not have been in effect during construction or operation of the store. The NFPA has not analyzed the Branford carpet store regarding its compliance with local codes and standards in existence when the store was built and during its operation.

The cooperation and assistance of the Branford Fire Department and the Connecticut State Fire Marshal's Office are greatly appreciated.

II. BACKGROUND

Occupancy Classification

The carpet store was in a 7,200-sq ft (669-sq m) building that contained showroom areas, offices, and a warehouse area. (See Figure 1.) Each area had at least one exit providing direct access to the exterior of the building. Both the office area and the warehouse supported the facility's primary function, namely, the retail sale of carpet and tile products. Since the facility was primarily a store, the Branford carpet store will be considered a Class B Mercantile Occupancy according to the 1994 edition of *NFPA 101®*, *Life Safety Code®*.^{1,2}

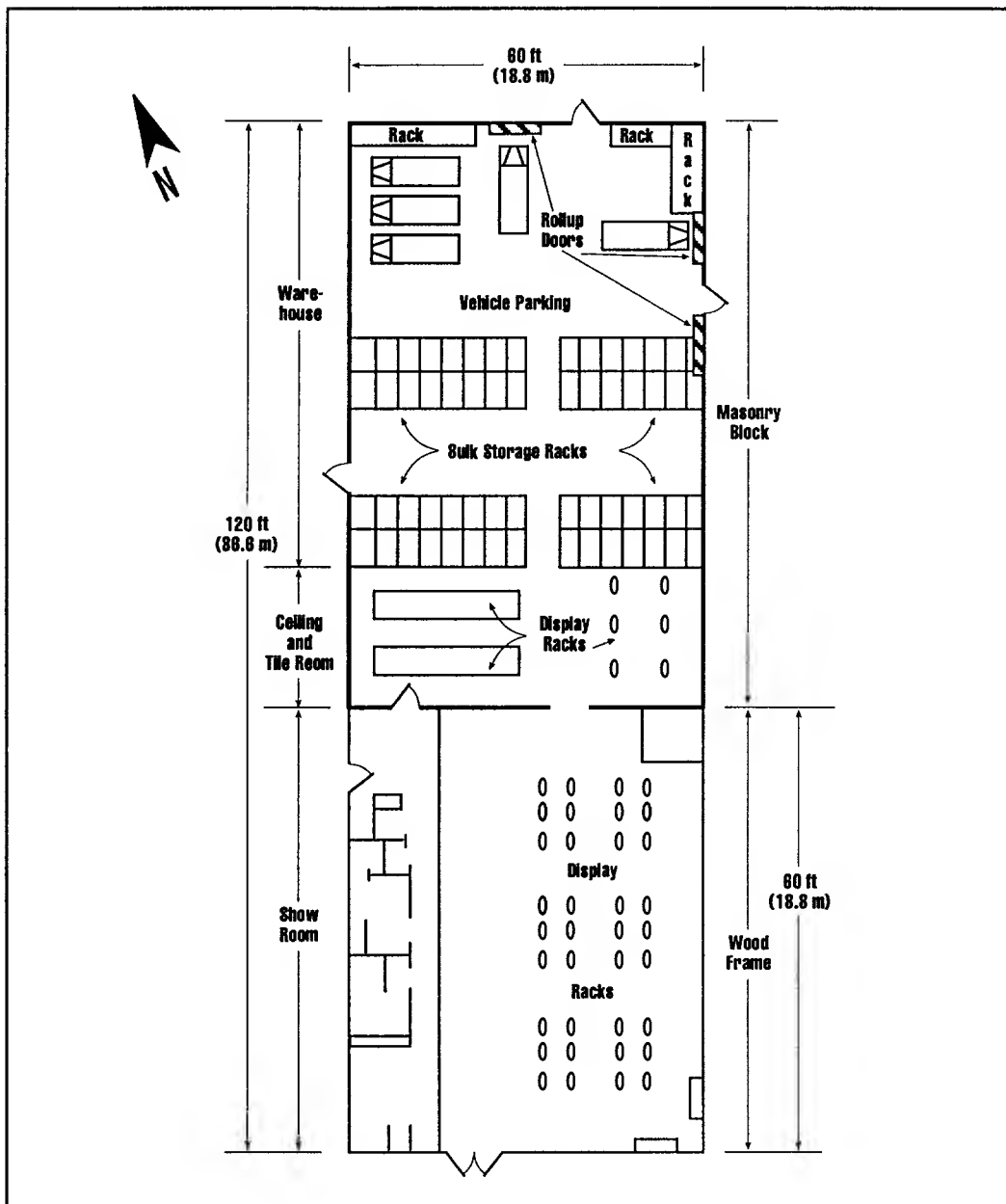


Figure 1: Plan view showing carpet store

¹ *Life Safety Code* and *101* are registered trademarks of the National Fire Protection Association, Quincy, Massachusetts.

² The *Life Safety Code* defines a Class B Mercantile Occupancy as a store having an aggregate gross area of more than 3,000 sq ft (280 sq m) but not more than 30,000 sq ft (2,800 sq m).

Applicable Codes and Enforcement

At the time of this fire, the City of Branford, Connecticut was enforcing the 1993 edition of the Connecticut Fire Safety Code which was based on the 1991 edition of the NFPA 101, Life Safety Code with State of Connecticut amendments.

The Building

The 60 ft (18 m) wide and 120 ft (36.6 m) long building was constructed in approximately 1960 and had been constructed on a concrete slab. The front third of the building had exterior bearing walls constructed with 2-in. x 6-in. wood studs. These walls had a plywood exterior finish and a gypsum wallboard interior finish. The rest of the building had concrete block exterior bearing walls. There was no apparent fire-rated separation between the two types of construction.

The roof assembly for the entire building was constructed with lightweight wood trusses installed on 24-in. (610-mm) centers. The trusses were supported by the building's exterior walls only so the trusses provided a clear span of 60 ft (18 m). They were triangular in shape and had a peak that was 8 ft (2 m) above the bottom chord. The top chords were 2-in. x 8-in. members, the bottom chords were 2-in. x 6-in. members, and the webs between the chords were 2-in. x 4-in. members. Metal gusset plates were used as connectors between the truss members. The trusses were covered by 5/8-in. (15.9-mm) thick plywood sheathing. The roof's water seal was provided by fiberglass or asphalt shingles. The truss void between the ceiling and roof was open from one end of the building to the other. As a result, this building had a 7200-sq ft (669-sq m) combustible concealed space above the ceiling.

Since the entire building was constructed with wood roof trusses and there was no fire separation between the area with wood-frame walls and the area with concrete block walls, the entire building will be classified as Type V (000) construction according to NFPA 220, *Standard on Types of Building Construction*, 1992 edition.³

The building had two showrooms, an office area, and a warehouse. The facility's carpet showroom and office area were located in the front third of the building. This part of the building had the wood frame exterior walls. A masonry block wall separated the carpet showroom from the ceiling and tile showroom. This wall had two openings through which occupants could pass. One was a doorless opening in the carpet showroom. The other had a door and provided access to the office area. A wood frame, nonbearing wall covered with gypsum wallboard separated the ceiling and tile showroom from the warehouse area. The ceilings in the office area, and the carpet showroom were approximately 10 ft to 12 ft (3.0 m to 3.6 m) above the floor. These ceilings were constructed with gypsum wallboard nailed directly to the bottom chord of the wood trusses. Investigators were not able to confirm the ceiling construction in the ceiling and tile showroom. The ceiling in the warehouse area was 14 ft to 16 ft (4.3 m to 4.8 m) above the floor. Reportedly, this ceiling was a rigid foam plastic insulation secured to the bottom chord of the roof trusses.

The building contained a variety of combustible and flammable fuels. The office

³ A Type V (000) structure will have a 0-hour fire rating for the exterior bearing walls (first digit); a 0-hour fire rating for structural frame or columns and girders supporting loads for more than one story (second digit); and a 0-hour fire rating for the story assembly (third digit).

area had furnishings, office supplies, office equipment, and many other combustible materials. The carpet showroom had carpet samples and displays that were made of combustible materials. The ceiling and tile showroom also had displays made of combustible materials and miscellaneous combustible materials. The warehouse had large quantities of combustible carpeting, combustible package materials, and many other combustible materials. In addition, five service vans with gasoline engines and a propane-powered lift truck were parked in the warehouse. One propane cylinder was on the lift truck, and two extra propane cylinders for the lift truck were also stored in the northeast corner of the warehouse. Several small cylinders for hand-held torches were also in the warehouse.

Heating, Ventilating and Air-Conditioning (HVAC) Systems

The building had four independent ceiling-mounted natural gas-fired heating units in the warehouse. In addition, one ceiling-mounted gas-fired heating unit in the ceiling and tile showroom heated that room. This unit also provided heat to the carpet showroom and the office area through a network of ducts. According to the property owner, the gas to all the units had been shutoff prior to the fire.

There were no air-conditioning units in the building.

Fire Protection Systems

The building had no built-in fire suppression, detection, or alarm systems. The building did have a burglar alarm system that used electronic contacts on the doors. The burglar alarm system was configured to send an alarm to a central station facility. The system was not operational on the day of the fire.

The Fire Department Overview

The Town of Branford is situated in south/central Connecticut on Long Island Sound. The community has a population of approximately 34,000 residents. The area covered is approximately 27 sq miles (70 sq km).

The Branford Fire Department was a combination department consisting of 20 career personnel, approximately 25 part-time emergency medical service personnel, and 120 volunteer fire fighters who responded from five stations. The department has a Board of Fire Commissioners, who appointed a full-time Fire Chief/Fire Marshal, two volunteer Assistant Chiefs who performed administrative functions of support services and had fireground command responsibilities. There were two volunteer Deputy Chiefs who performed administrative functions related to apparatus/facilities and performed fire prevention activities. On shift there was a career Deputy Chief, who also served as a Deputy Fire Marshal and four fire fighters of whom most were cross-trained as Emergency Medical Technician Intermediate (EMT-I) or Emergency Medical Technician-Paramedic (EMT-P). The part-time personnel were also trained to EMT or EMT-P level and staffed the second fire department ambulance. The volunteers belonged to seven different compa-

nies, in five different stations, usually in proximity with their residence. Each volunteer company elected a Captain, Lieutenant, and Second Lieutenant within that company.

The department fleet consisted of six engines, one aerial tower, two ambulances, two rescue units, one brush truck, three marine units, one command vehicle, and numerous staff vehicles. The typical response for a structural fire was a command officer, four engines, one ladder truck, one rescue unit, and a medical unit. Normally the shift commander responded by himself in a command vehicle, and two career fire fighters responded in one engine. If available, two cross-trained fire fighter/EMTs responded in the medical unit. Volunteer fire fighters would respond with the other engines, the ladder truck, and the rescue unit. On the day of this fire, the vehicle for the on-duty commanding officer was not operational. As a result, the commanding officer, a deputy chief, rode on the engine with a career fire fighter and a career deputy chief who was filling a fire fighter's position on that day.

The department career personnel worked a 42-hour workweek. The department provided fire suppression, emergency medical services, code enforcement, and public fire safety education to its citizens. The Town of Branford had a Class 4 ISO rating at the time of the incident.

Personal Protective Clothing and Equipment (PPE)

When ordering personal protective equipment for fire suppression personnel, the Branford Fire Department, reportedly specified that the protective coats and trousers meet the requirements of NFPA 1971, *Standard on Protective Clothing for Structural Fire Fighting*, 1991 edition.⁴ The outer shell was constructed of 7.5 oz PBI, with a Nomex® thermal liner, and breathable vapor barrier. The fire fighters were issued a 100% Nomex hood, structural fire fighting gloves that were specified to meet NFPA 1973, *Standard on Gloves for Structural Fire Fighting*, calf-length rubber boots that were specified to meet the requirements of NFPA 1974, *Standard on Protective Footwear for Structural Fire Fighting*, 1992 edition, and polycarbonate structural fire fighting helmets that were specified to meet NFPA 1972, *Standard on Helmets for Structural Fire Fighting*, 1992 edition. Both the victim and the severely injured fire fighter were wearing leather structural fire fighting helmets which reportedly OSHA requirements, but not NFPA standards. These helmets were purchased by the individuals. The fire department administration allowed the individuals to wear the helmets.

Self-Contained Breathing Apparatus (SCBA) were specified to meet the requirements of NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus for Fire Fighters*, 1992 edition. The Branford Fire Department had a documented SCBA maintenance program, that included quarterly air-testing and repair work done by a certified fire fighter. Any work not done by the fire department was done by the SCBA manufacturer.

⁴ NFPA investigators did not verify that personal protective clothing did, in fact, meet NFPA standards.

The Branford Fire Department had two different brands of Personal Alert Safety Systems (PASS). Both types of PASS alarms were specified to meet the requirements of NFPA 1982, *Standard on Personal Alert Safety Systems for Fire Fighters*, either the 1988 edition or the 1993 edition. The required maintenance was performed and documented by the SCBA technician. The PASS alarms were mounted on the shoulder straps of the SCBA harness.

Fire Fighter Training

The Branford Fire Department fire fighter certification training was performed in accordance with the State of Connecticut fire fighter certification program. The state program allowed certified instructors, using a state sanctioned curriculum, to provide training at the Branford Fire Department. Once all the training was completed, trainees were required to successfully complete an examination before being awarded their certification. In addition to the professional qualification training, members of the Branford Fire Department participated in ongoing training to maintain their proficiency.

The fire officers who were involved in the initial fire attack had many professional certifications. The incident commander, for example, had certifications for Fire Officer II, Fire Service Instructor II, Hazardous Materials Technician, Certified Fire Investigator and Emergency Medical Technician, and he had attained the rank of Deputy Chief. He had been a career fire fighter for 15 years and held his current rank for three years. The interior officer had attained all professional fire fighter certifications up to the position of Fire Officer II, was a certified Fire Instructor I, was an EMT-D, and had attained the rank of Deputy Chief. He had been a career fire fighter for eight years and held his current rank for three years.

Two fire fighters/EMTs who were assigned to Medic 1 were part of the interior operations, and both had diverse educational backgrounds and experiences. One Medic 1 crew member was a part-time fire fighter/paramedic and had been with the fire department for six years. In his full time position, he was the technical director for a regional ambulance service. This fire fighter had attained the State certification of Fire Officer I and was a certified Paramedic. The second Medic-1 crew member had been a career fire fighter for five years and a volunteer fire fighter for 16 years before that. All of his fire service experience was with the Branford Fire Department. This fire fighter had been certified to the level of Fire Fighter II.

Three fire fighters from Engine 5 were involved in the interior operations. The officer was a volunteer who had been with the fire department for seven years. He had earned the rank of Lieutenant and had held that rank for two years. His fire service training had been through the Branford Fire Department. His only certification was EMT-Basic. Like the officer, the two Engine 5 fire fighters' fire service training had been through the Branford Fire Department, and the only state certification for each was EMT-Basic. One of these fire fighters had been a volunteer for six years, and no information was provided as to the length of time that the second fire fighter had been with the department.

Similar to the Engine 5 fire fighters, the fire fighter who died in the incident had received his fire service training through the Branford Fire Department and his only state certification was EMT-Basic.

When questioned specifically about their training in building construction, all of the Branford fire fighters who were interviewed stated that they had received some instruction regarding building construction. However, none could recall at what level they had received that training. All but one of the fire fighters stated that the hazards associated with truss construction had been discussed at some point in their training.

Incident Command System

The Branford Fire Department used an incident command system because it recognized that effective functioning of fire department units and personnel required a clear incident command structure. The department's Standard Operating Procedure (SOP): Command Procedures stated that the first fire department unit or officer to arrive at the scene, to which multiple units are responding, shall take command. That individual would maintain command until relieved by a higher ranking officer or until the incident is terminated. The department's procedure required that command be assigned to a certain individual, that a strong, direct, and visible command be established as early as possible, and that command be transferred from one officer to another in an orderly manner.

Communications

The fire department's communication center was located within the Branford Police Department. The center was staffed with two civilian personnel per shift (8 hr shift), and was under the supervision of the duty officer of the police department. A sergeant from the police department was responsible for the day-to-day operation of the communication center. Dispatchers training was oriented toward emergency medical and law enforcement dispatching. There was no specific training on fire department dispatching; however, some dispatchers did have fire department experience.

On the day of the fire, the Branford Fire Department was operating on two frequencies. The primary fire department frequency was an Ultra-High Frequency (UHF) band and was used for dispatching and tactical fireground communications. Branford Fire Department's second frequency was a low-band frequency that was also used by surrounding departments. Because the fire department was operating on two radio frequencies, the dispatch center would simulcast information on both frequencies. The low-band radio system did not have private line (PL) capabilities that would delineate each individual fire station's transmissions or the transmissions from fire departments in other towns.

The Branford Fire Department had two radio frequencies because it was in the process of switching from the low-band radio system to UHF radio system. Since several communities used the same low-band frequency, radio transmissions in the

other communities would commonly override dispatching and tactical communications for the Branford Fire Department.

Since the Branford Fire Department was in the process of switching frequencies, not all fire department apparatus and personnel had UHF radio equipment. The career personnel used their own funds to purchase 20 UHF portable radios for themselves, and four apparatus had UHF portable radios. Similarly, several part-time and volunteer fire fighters had purchased their own UHF portable radios. These radios were not maintained by the Branford Fire Department.

The Branford dispatchers had a standing order to manually disable the low-band radio when other fire departments overrode the low-band frequency. The fire department incident commander could also order the dispatchers to disable the low-band radio system. The use of UHF radios only would eliminate the problem caused by transmissions from the adjacent communities. However, it also prevented responding apparatus and personnel not equipped with the UHF radios from getting information. The Branford fire officers recognized that occasionally, in previous fires, orders had not been received by responding fire fighters when the low-band system was disabled.

The Branford Fire Department listed 32 radio codes in their SOP regarding communications and unit designations. The listed signals were intended to keep radio transmission short and to provide concise messages having a universal meaning. All the signals fell into one of the following categories:

- Routine Messages
- Requests
- Emergency/Priority Messages
- Unit Status Messages
- Staff Messages
- Headquarters Messages.

Two of the emergency/priority messages that were relevant to the this carpet store fire were Signal One and Signal Two. Signal One was intended to be used only for the emergency evacuation of a scene. Branford Fire Fighters were instructed to sound the air horns on all fire apparatus at a scene when a Signal One was given. According to the SOP 202, Signal Two was to be used when a fire fighter was in a perilous situation.

The Branford Fire Department had 20 portable radios that were equipped with an emergency signal button. A fire fighter could use this button to initiate a signal if he or she was in trouble or danger. The emergency signal button was a small recessed button located on the top of the radio near the volume and channel selection knobs. Once activated, the emergency signal button would cause an alarm signal and display an identification number at the dispatch center. To eliminate the alarm, the dispatch center operator would have to manually reset the system, and the operator would have to attempt to locate the individual possessing the portable radio.

Accountability

Over the years, the Branford Fire Department had attempted to institute two personnel identification systems. However, neither of the systems was fully developed or implemented at the time of the fire. Additionally, no written procedure had been developed regarding how either of the personnel identification systems was to be used by members. Neither of the systems was described in the Branford Fire Department SOP.

The department's first fire fighter identification system was initiated in approximately 1993 by fire officers who recognized the need for a fireground accountability system. Each fire department member was to receive two numbered brass tags that would identify the member. The tags were made of brass so they would not deteriorate while the member was working in high-heat environments. Upon arriving at a scene, the member would leave one tag on the apparatus to which he was normally assigned, and the member would keep the second tag. Several manufacturing and information problems delayed the production of the brass tags. As a result, many fire fighters had not received their tags at the time of this incident, and the system had not been implemented. In the absence of procedural information, some members attempted to use the brass tags as part of an ad hoc accountability system.

In October 1994, the Branford Fire Department developed a second system which would not only identify the department members, but would indicate the type of training (medical or fire suppression) that the member had. To accomplish this, the department designed an identification tag with the member's photograph and color-coded bars signifying the member's level of training. A red stripe on the tag signified that the member was trained to, at least, the Fire Fighter I level, and a blue stripe signified that the member was certified as an EMT. A member of the Branford Fire Department stated that occasionally the badges reflected levels of training that had not been achieved by the possessor of the badge. As a result, the badges could not be considered an accurate means to quickly determine a member's training level.

Even though there was no written plan regarding the tags being used as part of a fireground accountability system, members, again, attempted to use the photograph identification tags as part of an ad hoc accountability system. Some of the volunteer fire fighters who were interviewed stated that they had been instructed to leave their photograph identification card on the fire department vehicle on which they rode to the scene. They were also told to leave it on the fire department vehicle that was being used in the suppression operation if they came by their own vehicle. The fire fighters believed that the information regarding the tag usage came from the fire department's administrators. When asked how they were instructed about this procedure, the fire fighters could not recall. Another volunteer fire fighter did not recall having received any instruction regarding how the tags were to be used.

At about the same time that the brass identification tag system was initiated, the Branford Fire Department also initiated an informal procedure for organizing per-

sonnel on the fireground. This procedure called for any personnel who did not respond on fire department apparatus to report to a staging area that was usually designated by a salvage cover placed on the ground. All personnel in the staging area were required to have full personal protective equipment. Crews would be selected from the assemblage. On the day of carpet store fire, fire fighters ignored this organizational system because over the years fire officers stopped enforcing its system.

At the time of this incident, the Branford Fire Department did not have in place an accountability system that would track personnel by either location or function. As a result, the shift commander used his discretion as to how fire fighters were to be tracked and accounted for on the fireground.

Occupant Load

The building was closed for business. All doors were locked, and no one was in the building.

Weather Conditions

At the time of the fire, the skies in Branford, Connecticut, were overcast. The temperature at 4:30 p.m. was 38 °F (3 °C) to 40 °F (4 °C), and intermittent snow flurries were occurring. There was no wind. These conditions were typical for Branford at this time of the year.

III. THE FIRE

Fire Department Notification and Response

At approximately 4:24 p.m. on Thursday, November 28, 1996, the Branford Fire Department was notified of a fire at a carpet store at 43 School Ground Road. The Branford Fire Department dispatched a standard response of Engine 1, Engine 2, Engine 5, Engine 8, Medic 1, Rescue 1, and Aerial 1.

The medical unit that was assigned to this fire was staffed by two paramedic/fire fighters. This unit was out of the fire station at the time that the fire companies were dispatched. The medic unit responded from its location and arrived on the scene first. At 4:30 p.m., a few moments before the first engine company arrived, one of the paramedic/fire fighters on the medical unit radioed the dispatch center that they had arrived. This fire fighter gave an initial building description and reported a “working fire.” Moments later, Engine 1 arrived, and the fire fighter/paramedic passed the command over the radio to the officer of that company. The officer accepted command at that time. Then, the two fire fighters on the medic unit left their vehicle and began putting on their protective gear.

The shift commander, a deputy chief, rode on Engine 1 because his vehicle was not operational. Another deputy chief was also riding on Engine 1. This deputy chief was working an extra shift and filling the fire fighter position on this engine.

While the companies were responding, the dispatch center relayed information that fire was breaking out of the windows which would have indicated a serious fire to the responding fire fighters. However, upon arrival, the fire fighters found no broken windows and no fire visible on the exterior of the building. A light to moderate smoke was seeping out of the front part of the building.

Engine 1 stopped at a hydrant and the deputy chief/fire fighter stepped out of the engine. He removed the engine’s hydrant equipment and wrapped the end of the supply line around the hydrant. The deputy chief/fire fighter returned to the engine, and the driver drove to the front of the fire building. Having the first engine lay a supply line as it approaches the scene was a standard procedure for Branford fire fighters. Since Engine 1 had laid a supply line, a following engine could complete the hydrant connection and pump to Engine 1.

The incident commander left Engine 1 and proceeded up to the fire building to begin his initial size-up while the supply line was being removed from the engine. As this officer approached Side 1 and Side 4 corner of the building, he found light brownish-gray smoke showing near the roof eaves and coming from soffit vents.⁵ (See Figure 2.) The smoke appeared to be coming from the wood-frame section of the building, and the smoke was heaviest in the back of this section near where the construction changed to masonry block.

⁵ As a standard practice, this department labels the front or street-side of the fire building “Side 1” for command purposes. From that reference point, each building side, progressing in a clockwise direction, is assigned a number. This approach for describing a building was applied to the carpet store.

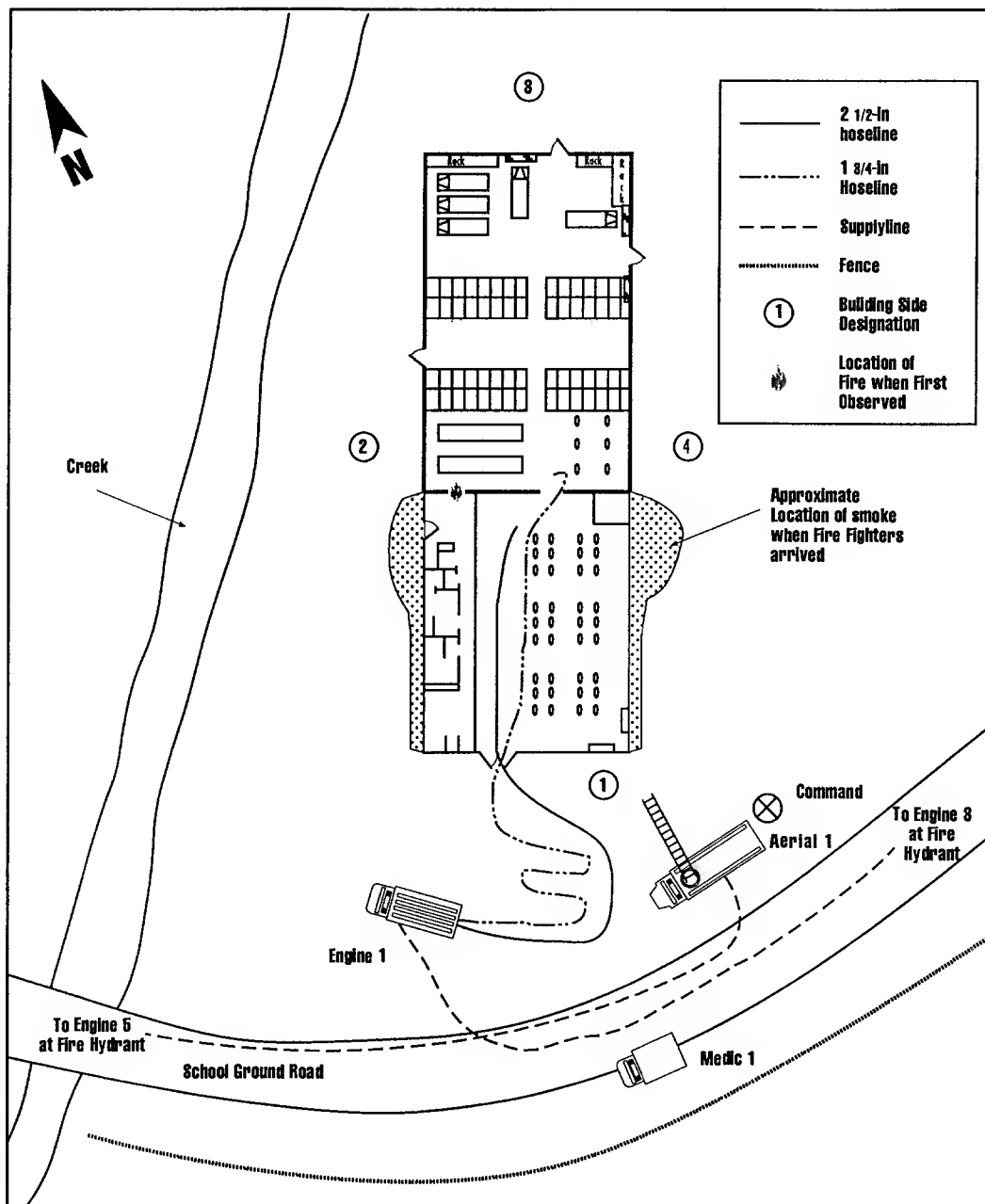


Figure 2: Fireground operation

The building owner met the incident commander at the front of the building and told him that no one was in the building. The owner also told the incident commander that the gas was turned off but there were containers of propane and gasoline, and vans in the back of the building.

The incident commander continued his initial size-up and went around to Side 2. He found the same light brownish-gray smoke coming from eave vents as he had seen on Side 4. Since the smoke was not pushing or billowing out of the building under pressure, the incident commander believed that the fire must be relatively small and in the front part of the building.

As Engine 1 approached the building, the deputy chief/fire fighter told the driver to position his apparatus in a parking lot near the building's front (Side 1) door. The

deputy chief/fire fighter on Engine 1 also performed his own size-up of the building and noted that there were two large garage doors and a personnel door on Side 4 near the rear of the building. When the vehicle stopped, the deputy chief/fire fighter pulled a 1 3/4-in. (44-mm) hoseline and brought it to the front door of the building. A volunteer fire fighter who had arrived in his own vehicle helped the deputy chief/fire fighter stretch out the attack hoseline. Because he had not put on his protective gear yet, the volunteer did not approach the building. At about this time, the two fire fighters from Medic 1 went to Engine 1 and put on self-contained breathing apparatus that was carried on that vehicle.

While the incident commander was doing his size-up, two volunteer fire fighters who had also arrived in their own vehicles came to the incident commander asking for instructions. Since he was still formulating his attack strategy, the incident commander told them to standby while he finished his size-up. Shortly thereafter, the volunteer fire fighter left his position. One of these fire fighters was a volunteer fire fighter who, reportedly, was assigned to Engine 5 and would later enter the building with the attack crews.

The deputy chief/fire fighter looked in the building's front doors and saw a heavy layer of smoke in the showroom. The smoke was coming down from the ceiling and was approximately 3 ft (1 m) above the floor. On the basis of these conditions and the fact that smoke was visible on the outside of the building, the officer believed that the fire was located somewhere in the showroom area. The two fire fighters from Medic 1 joined the officer. Since the door was locked, one of the Medic 1 fire fighters got an ax to break out the glass front doors.

Engine 5 arrived on the scene at 4:32 p.m. Six fire fighters were on this engine. One of the fire fighters was left at the hydrant where Engine 1 had positioned its unconnected supply line. This fire fighter was supposed to complete the connection for the Engine 1 crew. The incident commander ordered Engine 5 to reverse lay a second supply line for Engine 1. In response to this order, the Engine 5 driver and one member of the Engine 5 crew drove to a hydrant that was west of the fire building. Before Engine 5 left for the hydrant, three fire fighters left the vehicle and stayed at the scene. These fire fighters stretched a preconnected 2 1/2-in. (65-mm) hoseline from Engine 1 to the front of the building. The incident commander intended that this be used as a back up to the 1 3/4-in. (44-mm) hoseline that was already in position for entry. With two crews being assigned to the interior attack, the deputy chief/fire fighter from Engine 1 assumed the role of interior operations officer.

Engine 2 arrived at 4:34 p.m., and the vehicle was parked approximately 100 feet from Engine 1. The engine 2 crew left their vehicle and walked to Side 1 where they met the incident commander.

At 4:36 p.m., the incident commander radioed the dispatch center and reported that Engine 1 and Engine 5 had laid supply lines and that an interior fire attack would be used. Aerial 1 also arrived on the scene, parked near the front of the building

and began preparing for an aerial operation in the event it case the incident commander gave them the order. During these activities, one of the Aerial 1 crew members got into the bucket. While in the bucket, and observed a glow in the gable vent for the masonry block part of the building. This information was not communicated to the incident commander.

As more volunteer fire officers and fire fighters arrived, many went to the incident commander asking for individual instructions. These questions continued to serve as a distraction for the incident commander.

While attempting to charge the hoselines using his tank water, the Engine 1 driver/pump operator discovered that he had a possible pump problem. Whenever he attempted to engage the fire pump, an indicator light confirming that the pump was engaged failed to illuminate. The driver/operator had attempted to engage the pump several times when the incident commander came to his position to determine why there was a delay getting water to the two hoselines positioned at the front of the building. The officer and driver determined that the problem involved the indicator light and not the pump so they continued to use Engine 1 to support the hoses that had been stretched from this vehicle.

Many activities occurred while the crews were waiting for the hoselines to be charged. The fire fighters positioned by the front door had time to break open the front doors and to secure them in the open position. When the doors were opened the interior officer saw heavy black smoke discharge from the building and pass over the heads of the fire fighters near the front door. That smoke quickly turned a white/gray color. Rescue 1 also arrived on the scene. The incident commander had them get a positive pressure ventilation (PPV) fan and bring it to the front of the building. The incident commander's plan was to push the smoke into the rear of the building in order to increase visibility for the attack crews. The fire fighters turned the fan on briefly. It did not work properly so the fire fighters removed the fan from the area immediately in front of the doors.

When the Engine 2 crew met the incident commander on Side 1 of the building, he initially planned to make this crew his rapid intervention crew (RIC). Since the ventilation fan was not working properly, the incident commander decided instead to have this crew break out the large windows at the corner of Sides 1 and 4. The incident commander also had a member of the Engine 2 crew verify that the gas in the building had, in fact, been shut off.

More volunteer fire fighters and volunteer officers arrived on the scene in their own vehicles, put on their protective gear, and continued to blend into the fireground operations. One of the volunteer deputy chiefs quickly observed the conditions inside the front of the building and then continued around the building to verify the conditions on other sides of the building. As he walked along Side 2, he found conditions suggesting that there was fire inside the door closest to the front of the building. He continued checking doors and found that Side 2 closest to the rear of the building was locked and that the doors on Side 3 were locked. After complet-

ing his inspections of the doors the deputy chief returned to the Side 1.

In the period before the fire fighters entered the building, both the incident commander and the interior officer planned that two hoselines were to be brought into the building. They recognized that these hoselines were to be handled by three fire fighters on each line. The interior officer and the two Medic 1 fire fighters had the 1 3/4-in. (44-mm) hoseline. The Engine 5 officer, and two of his crew had the 2 1/2-in. (65-mm) backup hoseline. All of these fire fighters had full protective gear including SCBA's. The Engine 1 officer, Engine 5 officer and both Medic 1 fire fighters had portable radios. All of these radios were turned on when the crews entered the building.

While the two crews waited at the front door, the Engine 5 fire fighter who had arrived earlier in his own vehicle, and who left his identification tag on Engine 1, joined the fire fighters on the 1 3/4-in. (44-mm) hoseline. During an interview after the fire, the incident commander stated that he was not aware that the volunteer fire fighter had joined one of the interior crews. The interior officer stated that he did not initially recall that the volunteer fire fighter had joined the attack crews. The post-fire interviews and review of activities revealed, however, that the interior officer and the Engine 5 fire fighter had spoken with each other briefly before the crews entered the building. The volunteer deputy chief who observed conditions on Side 2 of the building also observed activities at the front of the building as the crews made entry and provided assistance as needed. This officer had not been assigned a supervisory role on this side of the building.

The Engine 1 driver operator charged the 2 1/2-in. (65-mm) hoseline first and, seconds later, charged the 1 3/4-in. (44-mm) hoseline. Once they had water, both crews entered the building at the same time. As they advanced their hoselines through the carpet showroom, the smoke maintained its 3 ft to 4 ft (0.9 m to 1.2 m) height above the floor. There were no unusual noises and no perceivable heat. Visibility below the smoke was very good. The fire fighters could see the wall to their left, and to their right was a table, chairs, and carpet display racks. The two crews stayed close together. They could touch each other as they advanced the hoselines into the building. As they got farther into the carpet showroom, the interior officer could see a red glow on the other side of the opening separating the two showrooms.

While the two crews were advancing the hoselines inside the building, the volunteer deputy chief who checked the doors on Sides 2 and 3 reported to the incident commander and asked if the incident commander wanted the rear door on Side 2 opened. The incident commander agreed so the assistant chief had additional fire fighters bring an 1 3/4-in. (44-mm) hoseline and a 1 1/2-in. (38-mm) hoseline to outside of the rear door on Side 2 of the building. Over time, these fire fighters were able to get the door open. The deputy chief found the floor area to be clear, but fire was spreading at ceiling level. References to the door opening activities were, reportedly, noted on the radio transcripts at 4:30 p.m.

Inside the building, the fire fighters began to experience problems moving both hose-

lines so the interior officer ordered one of the fire fighters to go back and free them. In response to this, one of the Engine 5 fire fighters on the 2 1/2-in. (65-mm) hose-line left. He was able to free the 1 3/4-in. (44-mm) hoseline first, and the crew on that hoseline began to move forward again.

At about this time, the incident commander radioed the interior officer and asked if they had found the seat of the fire. The interior officer replied that they had found a fire and were attempting to extinguish it. The interior officer also told the fire fighters who were still moving the 2 1/2-in. (65-mm) hoseline of his plan for attacking the fire.

One of the Medic 1 fire fighters realized that there were four fire fighters, including himself, on the 1 3/4-in. (44-mm) hoseline. Thinking that one of the fire fighters from the 2 1/2-in. (65-mm) hoseline must have moved over to his hoseline, the Medic 1 fire fighter believed that there were only two people moving the larger hose. The Medic 1 fire fighter thought that they wouldn't be able to move the charged 2 1/2-in. (65-mm) hoseline by themselves so he moved over to that hoseline without informing his officer.

The interior officer went to the opening in the masonry block wall between the carpet showroom and the ceiling and tile showroom. He found fire on the back side of that wall. The fire was to his left and about 20 ft (6.1 m) away from him. He saw flames close to the floor, flames higher on the wall, and a glow up in the smoke indicating there were flames higher in the smoke. When the fire fighters brought the 1 3/4-in. (44-mm) hoseline to the officer's position, the officer instructed the fire fighter to "hit the high fire, hit the low fire and shut down." The officer also told everyone to be quiet so he could listen for sounds that might indicate that the fire was still burning.

Before the fire fighter had a chance to discharge his hoseline, the low-air alarm for one of the Engine 5 fire fighters on the 2 1/2-in. (65-mm) hoseline sounded. Everyone stopped for a moment and checked their alarms and identified who had the operating alarm. The interior officer ordered the individual out of the building and the fire fighter with low air began to move toward the building's front door.

Once the Engine 5 fire fighter was ordered out of the building, the Medic 1 fire fighter at the nozzle of the 1 3/4-in. (44-mm) hoseline attacked the fire. This fire fighter did as he had been instructed; he hit the high fire, hit the low fire, and shut his nozzle. The smoke in the area immediately became thicker and condensation collected on the fire fighters' face pieces. The interior officer insisted that everyone stop their activities and be quiet. He listened, and then he knew from the sounds that the fire was above their heads, and immediately ordered everyone out of the building.

On the outside of the building, the assistant chief who was working with the crews on Side 2, reportedly, observed the fire starting to spread along the eaves near the

front of the building. He stated that he went to the incident commander and reported this observation. It was about this time that the incident commander saw one tab of one shingle above the wood-frame part of the building fall off. This shingle was on the roof surface facing Side 4 and near the section with masonry block walls. The incident commander, who was outside the building, saw small flames shoot out of the opening. He immediately knew that there was a large body of fire above the crews inside the building. The incident commander radioed the interior crews and ordered them out of the building. This order came at almost the same time as the interior officer's command for evacuation.

The incident commander also radioed the dispatch center at 4:46 p.m. and reported a "Signal One" which is a Branford Fire Department code requiring an immediate evacuation of fire fighters in a building. In response to this code, all fire department vehicles operating at a fire scene were supposed to sound their air horns signaling for an immediate building evacuation. After broadcasting the "Signal One" over the radio, the incident commander who was positioned near Engine 1 told the driver of that engine to sound his air horn. The dispatch center recorded that the "Signal One" was initiated approximately 16 minutes after the fire fighters arrived on the scene.

The Medic 1 fire fighter who had moved over to the 2 1/2-in. (65-mm) hoseline had a radio with him, and he heard the incident commander order everyone out of the building. This order surprised the fire fighter because he felt the conditions in the building were not bad and he couldn't see any fire over his head. He was beginning to feel a little heat, but he thought that was natural because he had been approaching the fire. The Medic 1 fire fighter also recognized that the incident commander probably had other information about conditions so, following the order, he began to leave the building.

Immediately after the interior officer and the incident commander gave orders to evacuate, the interior officer told a fire fighter who was with him to follow the hoseline out of the building. Just as they began to move towards the front door, they could hear the air horns outside the building sounding.

Suddenly there was a noise and debris started falling from the ceiling. The Medic 1 fire fighter on the 2 1/2-in. (65-mm) hoseline described the noise as being similar to two trains passing with one being on each side of him. Material hit him on the back and partially knocked him down. He realized that the material was burning, and everyone around him was screaming to get out. The opening at the rear of the carpet showroom was covered with debris so he knew that he had to go out the front door to the building. This fire fighter and the two Engine 5 fire fighters were able to find the hoselines and follow them to the front door of the building.

The incident commander ran to the front of the building. He found one of the Engine 5 fire fighters already outside of the building, and then he heard the loud noise and a large volume of smoke was pushed out of the building. He immediately knew that the roof had fallen. Moments later, three more fire fighters crawled out. Four

of the original known six fighters were safe. The incident commander also knew this meant that two fire fighters were still in the building.

The incident commander yelled for four fire fighters equipped with SCBA to initiate a rescue attempt. To the incident commander it seemed that no one responded to this order. However, several fire fighters had heard his order and went to Side 2 to get the hoselines that had been placed by the rear door in order to reposition those hoselines at the front entrance.

The commander thought the missing fire fighters had to be close behind the fire fighters who escaped and radioed the interior officer. There was no reply.

Moments later, the incident commander heard the yelling over the radio and realized that the trapped fire fighters were still alive somewhere. The incident commander, again, yelled for four fire fighters to start a rescue attempt. The incident commander momentarily entered the building by himself. He saw large sections of roof had fallen and knew that he could go no further by himself so he left the building and returned to his command position between Sides 1 and 4.

The interior officer was the first to free himself from the debris and after standing up, he realized that he had not moved from the location he was in before the collapse. The officer then saw two fire fighters who appeared to be trapped in the rubble as they were attempting to escape out the front showroom doors. These fire fighters were apparently members of the Engine 5 crew who had been moving the 2 1/2-in. (65-mm) hoseline. The officer found the 1 3/4-in. (44-mm) hoseline and began spraying water onto the pile of burning debris in the area of the other fire fighters. Despite his efforts, the fire grew quickly and he lost sight of those fire fighters.

The Engine 5 fire fighter who had left his tag on Engine 1 freed himself next. This fire fighter stood up from the rubble and was in a position next to the interior officer. The fire fighter didn't say anything to the officer, and the officer did not recognize the identity of this fire fighter. Remembering that he had seen some large overhead doors in the rear of the building, the officer told the fire fighter that they had to get out of there and that they had to go through the back of the building. When the officer turned around, the fire appeared to be involving the entire warehouse portion of the building.

At about this time, the officer saw a light shining in the debris and realized that there was another fire fighter under the fallen material. This fire fighter was lying face up with rubble on top of him, and he had an arm out stretched. The officer gave the nozzle to the Engine 5 fire fighter and told him to protect the officer while he uncovered the trapped fire fighter. The fire fighter sprayed water while the officer freed the Medic 1 fire fighter. When the officer asked the Medic 1 fire fighter if he was all right, that fire fighter gave an affirmative nod.

The interior officer again told everyone that they would have to move to the rear of

the building. In the post-fire interviews, the officer stated that he made a radio transmission to report that he and the Medic 1 fire fighter were trapped. In this transmission, he used only his and the Medic 1 fire fighter's names because he did not know who the third fire fighter was. The last time that the officer saw the unidentified fire fighter, he was still spraying water on the officer and Medic 1 fire fighter.

The officer told the Medic 1 fire fighter to grab the third fire fighter because they all had to go toward the back of the building. The Medic 1 fire fighter who was, apparently, disoriented had not seen the Engine 5 fire fighter. The Medic 1 fire fighter believed that the officer who was speaking through his SCBA face piece asked "where the other fire fighter was." The Medic 1 fire fighter responded that he did not know where the third fire fighter was and that the fire fighter must have already escaped.

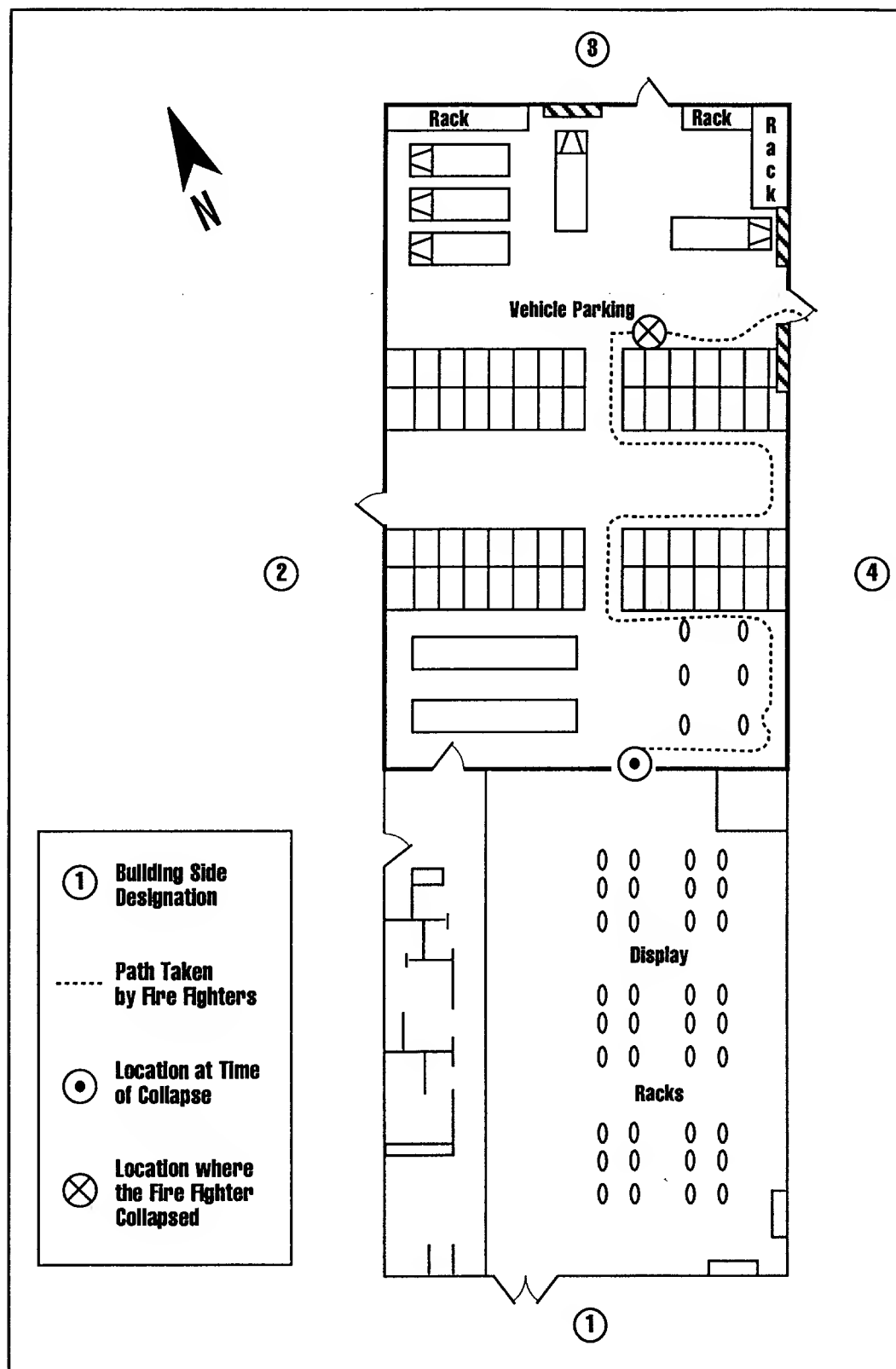
The officer who was in physical contact with the Medic 1 fire fighter began moving through the thick smoke that was so heavy that his hand light penetrated only 3 in. to 4 in. (75 mm to 100 mm). They took tiny "baby" steps feeling their way along the wall, through display racks and over debris. As they moved through the smoke hoping to find a door, the officer stated that he couldn't help but think about Hackensack, New Jersey where other fire fighters had been trapped and wondered if he would make it out of this building.

The officer and the Medic 1 fire fighter continued to feel their way through the building following the path shown in Figure 3. As they moved through the building and many obstacles, they were yelling in order to communicate with each other. At one point, the officer thought he had reached a door but it turned out to be a wall-mounted display rack. At another time, he thought they had walked into an office and would not be able to find their way out. Despite these disorienting experiences, the officer and fire fighter kept moving through the smoke-filled building.

The incident commander continued to hear yelling, but, had no idea as to where the fire fighters were in the building. Hoping that the trapped fire fighters might be able to find their way to a door, the incident commander radioed a general order to have all doors opened up. This order was given at 4:49 p.m. Though the fireground chaos level was rapidly increasing, the crew from Engine 2 responded back to the incident commander and indicated that they would start on Side 2. The rear door on Side 2 had already been opened by volunteer fire fighters earlier in the fire.

When the trapped officer and fire fighter entered the part of the warehouse where the vehicles were parked, the Medic 1 fire fighter's air ran out. He took off his face piece and continued further only a short way. He was overwhelmed by the smoke and collapsed approximately 40 ft (12.2 m) from a door. The fire officer tried to pull the fire fighter out of the building but he was too big and heavy. The officer decided to continue on so he could find an exit and get assistance.

Figure 3: Path taken by fire fighters in their attempt to escape



The officer found one of the overhead garage doors. This door was covered by wood boards, and the officer realized that he could not open it. He continued to search in the darkness and smoke until he found a personnel door. It was locked. Unable to see the door, he began feeling the entire door to determine what type of lock or locks

secured the door. He determined that there were no dead bolts or sliding bolts at the top or the bottom of the door and that there were no padlocks on the door. The interior officer also radioed the incident commander and in his excitement made an unintelligible transmission. The incident command radioed back and asked the officer to repeat his message. At that time, the interior officer reported that he was by the garage loading dock. He continued feeling the door until he located the door-knob and a thumb latch for a dead bolt. He operated both of these devices, opened the door and left the building.

The interior officer saw Assistant Chief 4 near the corner of Side 4 and Side 1 near the front of the building. The interior officer gestured for assistance. It appeared to the interior officer that this chief was not going to come to the interior officer's position. Thinking that no one was going to assist him, the interior officer, in total frustration, believed that he would have to rescue the fire fighter by himself. He took off his gloves so he wouldn't lose his grip when he attempted to drag the injured fire fighter to safety and reentered the building.

The fire fighter who had collapsed in the warehouse was wearing a PASS (Personal Alert Safety System) device, but he had not turned it on before entering the building. As a result, the PASS alarm did not operate when the fire fighter stopped moving. The interior officer had no PASS alarm signal to guide him back to the injured fire fighter. Despite this, the officer found the fire fighter and dragged him out of the building to safety even though the fire fighter was much larger than the officer.

Assistant Chief 4 had seen the interior officer's gesture but did not understand why that officer was waving. The assistant chief walked to where he had seen the interior officer. By time the Assistant Chief reached the interior officer's position that officer had reentered the building.

A volunteer fire fighter from Engine 8 saw the interior officer after he had come out of the building the second time. He also saw the injured fire fighter lying near the door. After he helped to drag the fire fighter away from the building, the Engine 8 fire fighter reported that he had spoken with the interior officer who said there was another fire fighter inside the building. The Engine 8 fire fighter went towards the front of the building to relay the interior officer's information.

Once the incident commander learned the interior officer's location from his radio transmission, he ran to Side 4 of the building. On the way, the incident commander told an unidentified fire fighter to get a crew together. The order was not understood or went unheeded. The Engine 8 fire fighter met the incident commander as he was headed to the rear of the building. In passing, the Engine 8 fire fighter told the incident commander that someone else may still be in the building. The incident commander did not provide a perceivable response to this information.

The incident commander arrived at the garage doors on Side 4 and found the personnel door partially open. In addition, he saw an assistant chief, two fire officers, and a person in street clothes standing near the open door. The next thing he heard

was some one shouting “He’s out”. The time was approximately 4:51 p.m.

The interior officer told the incident commander that there was a fire fighter still in the building. The incident commander thought the interior officer may have been talking about one of the four fire fighters who had came out the front of the building and told the interior officer that everyone was out. The incident commander knew four fire fighters come out the front of the building. The incident commander also knew that the interior officer and the injured fire fighter made six. Therefore, he assumed everyone was out of the building.

Unable to convince the incident commander, the interior officer became frustrated because he knew someone had not escaped. Emergency medical personnel brought the interior officer away from the building and examined him for injuries. In response to the interior officer’s insistence and in preparation for their commitment to a defensive operation, the incident commander had company officers account for all of their personnel, and no one reported that anyone was missing. Fire officers and fire fighters alike believed that a tragedy was averted.

In the emergency room, the Medic 1 fire fighter regained partial consciousness. The injured fire fighter began asking about several of the fire fighters who had been in the building before the collapse. When the injured fire fighter made these inquiries, he used their first names. The last person that injured the fire fighter asked about was the victim. Branford fire fighters who had brought the injured fire fighter to the hospital contacted the incident commander and relayed the names that the injured fire fighter had mentioned. This was the first time the incident commander had heard the victim’s name being included as one of the interior fire fighters.

Realizing that there was a very good possibility that the interior officer was correct and that a fire fighter was trapped in the building, the incident commander felt he had to talk with the interior officer again. So that he would not be distracted from his inquiry about the missing fire fighter, the incident commander passed the command to a volunteer assistant chief, Assistant Chief 4. This occurred at some time between 4:55 p.m. and 5:00 p.m.

The first incident commander went to the interior officer to verify how many fire fighters were in the building, and they both agreed that they were aware of only six fire fighters. None of these fire fighters had the first name that the Medic 1 fire fighter mentioned. The officers tried to think of who the Medic 1 fire fighter might have been talking about. Suddenly, the interior officer remembered that, at some point earlier in the fire, a fire fighter had identified himself to the interior officer and that fire fighter had used a nickname. Moments later the interior officer recalled that nickname. With the first name and the nickname, the officers were able to identify the fire fighter. The officers looked over the area to see if they could locate the fire fighter’s vehicle and found it. At this point, the first incident commander realized that it was now very likely that one fire fighter had not escaped from the building.

At about this time, an off-duty deputy chief brought the victim's identification tag to the first incident commander. The fire fighter had found that tag lying on top of the metal shelf protecting the gauges of Engine 1's pump panel. Upon receiving the identification tag, the first incident commander was convinced that the missing fire fighter was in the building.

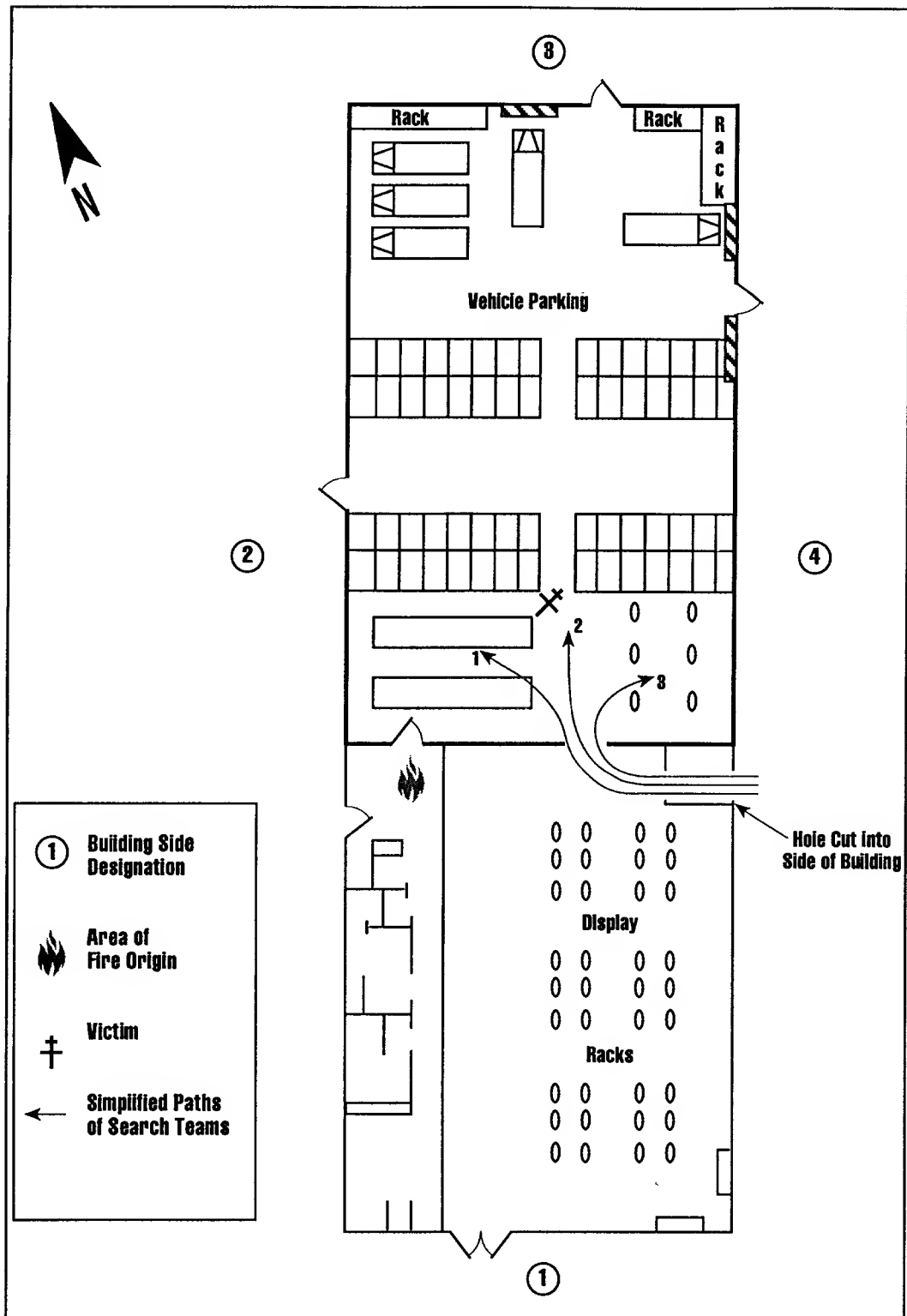
As word of the missing fire fighter began to spread, fire fighters wanted to go back into the building to begin an immediate search. The new incident commander recognized the need to ensure the safety of fire fighters despite their desire to immediately enter the building. He was attempting to formulate a strategy that would minimize the risk to rescuers. This change in command was not broadly understood on the fireground so many fire officers became confused as to who was in command.

In the absence of a perceivable fireground strategy, some fire fighters and officers began activities that they believed were appropriate. For example, the Engine 5 fire fighters felt that they had the best knowledge as to where the hoselines had been left and that they could start searching for the missing fire fighter from that point. They decided to use the 1 3/4-in. (44-mm) hoseline that had been repositioned at the front of the building and to reenter the building. They told a volunteer assistant chief of their intentions, and he supervised these activities from outside of the building. Before the fire fighters found that hoseline, the assistant chief ordered the fire fighters out of the building because he intended to have the ladder pipe begin operations to control the intense fire that was still growing.

The new incident commander consulted with other senior fire officers and developed a plan to get fire fighters into the building and to systematically search for the missing fire fighter. The officers decided to cut a hole in the wood-frame wall near the northeast corner of the carpet showroom even though they believed the missing fire fighter was in the part of the building that had masonry block walls. (*See Figure 4.*) Some of the officers recognized that the masonry block wall was beginning to appear unstable and felt that a breach of the wood-framed wall would pose less risk to the fire fighters who would be entering the building.

Once the ladder pipe controlled most of the severe fire in the center of the building, three search teams, with six fire fighters in each team, entered the building with hoselines. They moved slowly, extinguishing the fire as they advanced into the building. The crews working in the building were relieved several times by new crews. The missing fire fighter was found at approximately 7:30 p.m., three hours after the initial dispatch of fire crews. Once the victim was located, all Branford fire fighters were withdrawn from the building. The victim was pronounced dead at 8:00 p.m. by a medical doctor who was also a Branford fire fighter. The victim was removed from the building by fire fighters from other towns. These fire fighters had come to the scene and had offered their assistance.

Figure 4: Rescue operation



Casualties

One fire fighter died in this fire. He was found approximately 20 ft (6 m) from the position where he was last seen by the officer. The cause of the fire fighter's death was listed as smoke inhalation.

The victim's protective clothing, street pants, shirt, and under garments were severely burned. The wide brim on the back of the victim's leather helmet was consumed and a hole approximate 2 in. by 2 in. (50 mm by 50 mm) was burned through the upper part of the helmet on the back side. The front part of the helmet and the helmet liner were in good condition. The victim's SCBA face piece and PASS device were severely deformed. The SCBA harness straps were severely burned, the cylinder was intact, but the valve was deformed.

The Medic 1 fire fighter sustained a severe smoke related-injury. He was transported to a hospital where he was medically stabilized. The fire fighter was then transported to a second hospital where he was placed in a hyperbaric chamber as part of his treatment. He was released from the hospital three days later.

The Medic 1 fire fighter's equipment was in good condition. The only damage to his protective coat was a small burn spot on the reflective tape on the upper back. His pants had a small tear that occurred while he was being dragged out of the building. The damage to fire fighter's leather helmet was limited to the brim, but the helmet's plastic eye shields were melted.

One fire fighter from Engine 5 was also injured. He twisted his knee while working in the building during one of the rescue activities. This fire fighter was transported to the hospital by paramedics. He was treated and released on the same day.

The fatality and the injuries were not caused by any failure of the fire fighters' protective clothing.

Damage

The entire building was destroyed by this fire. All of the wood trusses above the warehouse area and most of the wood trusses above the two showrooms were consumed. The most severe damage to building contents occurred in the warehouse, and in ceiling and tile showroom. In these areas, nearly all of the combustible and flammable materials were consumed. The contents of the carpet showroom were heavily damaged and in the office area furnishings, office equipment, and other combustible materials were moderately damaged. (*See Photos 1 – 4.*)



Photo 1: Front of building (Side 1)

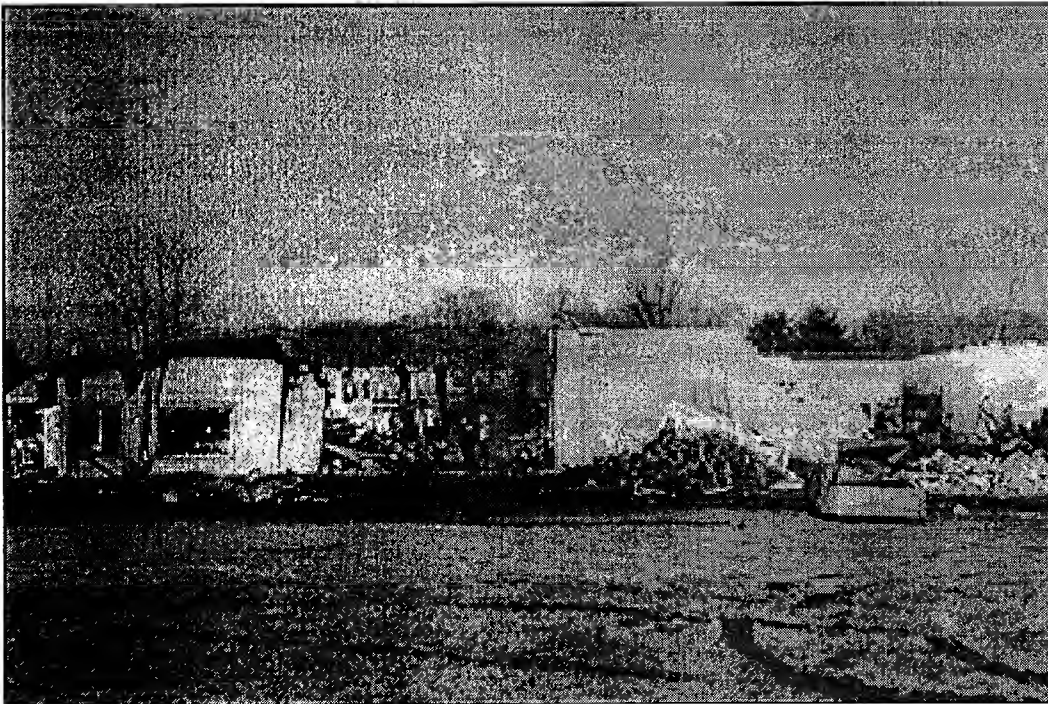


Photo 2: Left side of building looking from front to rear (Side 2)



Photo 3: Corner of building between rear and right sides (Sides 3 and 4)



Photo 4: Right side of building (Side 4)
Note: The men are standing in an area where walls had been removed for the cause investigation

IV. TIME LINE

Actual Time (HR:Min)	Running Time (Min:Sec)	Transmission
4:24 p.m.	00:00	Branford Fire Department dispatched first alarm units.
4:30 p.m.	06:00	Medic 1 arrived on scene.
4:32 p.m.	08:00	Engine 5 arrived on scene.
4:34 p.m.	10:00	Engine 2 arrived on scene.
4:36 p.m.	12:00	Incident commander radioed that Engine 1 and Engine 5 had laid supply lines. Aerial 1 arrived on scene.
4:46 p.m.	22:00	Incident commander announced a "Signal One."
4:49 p.m.	25:00	Incident commander ordered all doors in the building to be opened.
4:51 p.m.	27:00	Interior officer outside of the building.
4:55/ 5:00 p.m.	31:00/ 36:00	Incident commander transferred command to Assistant Chief 4.
7:30 p.m.	180:00	Victim found in building.

V. ANALYSIS

Origin and Cause

State and local fire investigators determined that the area of fire origin was the kitchen in the office area. Approximately three months after the fire, State of Connecticut fire investigators arrested the property owner and charged him arson that lead to death of the fire fighter.

Fire Growth and Spread

The door between the kitchen and the ceiling and tile showroom was open so the fire burning in the kitchen spread into the ceiling and tile showroom. This was the first fire found by fire fighters.

Before fire fighters had arrived on the scene, the fire had spread into the combustible concealed space above the ceiling in the office and carpet showroom. The means by which the fire entered that area could not be determined. State fire investigators believed that most of the fire was in the concealed space above the office and carpet showroom when fire fighters arrived on the scene. This belief was supported by the fact that initial collapse occurred over the carpet showroom and office area. The collapse started near the masonry block wall between the two showrooms and progressed toward the front (south end) of the building.

At the time that the fire fighters were initiating their attack, the fire was also spreading into the ceiling and tile showroom. The door between the office area and the ceiling and tile showroom was in the open position. As a result, the fire in the office was able to freely spread into the showroom when it became large enough to do so.

The Wood Trusses

Current architectural design and building construction practices promote the use of lighter materials which will reduce both material requirements and construction costs.⁶ One such practice is the increasing use of trusses. Trusses are construction elements that can carry loads over long spans, and at the same time, can reduce the size and weight of the load-carrying member, ultimately reducing costs without compromising performance under nonfire conditions. The trusses used in building construction can be made of wood, metal, or a combination of both materials. Both the shape of trusses and the size of the material used to make trusses can vary greatly according to individual truss design. Each of these variables will affect the performance of a truss under fire conditions.

Even though the fire was initially fueled by materials in the kitchen, the wood chords and webs of the trusses and plywood sheathing became the primary fuel for the fire once it entered the combustible concealed space. The concealed space was not used for storage or for any other documented purposes that would have placed com-

⁶ Brannigan, F. L., *Building Construction for the Fire Service*, National Fire Protection Association, 1992, third edition, pp. 517 – 518.

bustible materials in that space. Electrical wiring with combustible insulation was in the concealed space, but this was negligible when compared with the amount of wood in the trusses and sheathing material. Thus, in the absence of other fuels, it becomes clear the wood trusses and the wood sheathing materials were fueling the fire in the concealed space.

The wood trusses' ability to fuel the fire made them more hazardous than metal trusses would have been under similar conditions. Had the trusses been made of metal, the roof's sheathing material would have been the primary combustible material in the concealed space. The change in material used for trusses would have reduced the total amount of fuel, would have reduced the area of exposed combustible surfaces, and would have changed the geometric arrangement of the fuels to one with a lower potential of fire spread. The combined effect of these changes would have been a less severe fire in the concealed space.

With the elimination of fuels in the concealed space, risk to fire fighters would have been reduced for many reasons. The structural members supporting the roof would have been exposed only to whatever fire could spread from the kitchen into concealed space, reducing the number of exposed structural members' exposed to the fire and reducing the potential for a roof collapse. Additionally, the weakest structural members would have been limited to those extending over the fire. Either situation could have reduced the potential danger to fire fighters operating under the weakest structural members. That was not the case in Branford. With the fire burning over their heads and affecting several trusses in the concealed space, fire fighters unknowingly operated directly under weak structural members which were remote from the seat of the fire in the office area.

By the nature of their design, trusses create open areas between their top and bottom chords. The trusses above the Branford carpet store were 8 ft (2 m) high at the their peak and they were 60 ft (18 m) long. This design created a very large combustible concealed space which Brannigan refers to as a truss loft or truss void.⁷ The fire spread through this space quickly. As the wood trusses burned, they lost mass and lost strength increasing the potential for collapse under the trusses' own weight and the weight of the roofing materials, and increasing the threat to fire fighters who were working below the trusses.

The distance between supports for a truss (i.e., the truss's span) and the number of partitions under a truss affects the risk that a truss can present to fire fighters. In his book *Building Construction for the Fire Service*, Brannigan recognizes that the risk to fire fighters is less when a space contains a large number of interior partitions because the partitions will support the failing trusses allowing only pieces of the trusses to fall to the floor. (See Photo 5.) The same truss used in a commercial building to provide a wide clear span can fail catastrophically.⁸ Such a catastrophic failure occurred in the Branford carpet store. When the roof above the carpet showroom collapsed, large sections fell landing on shelves, countertops, and the floor. The fallen debris blocked the primary egress path for three fire fighters.

⁷ Brannigan, F. L., *Building Construction for the Fire Service*, National Fire Protection Association, 1992, third edition, p. 542.

⁸ Brannigan, F. L., *Building Construction for the Fire Service*, National Fire Protection Association, 1992, third edition, pp. 530 – 531.

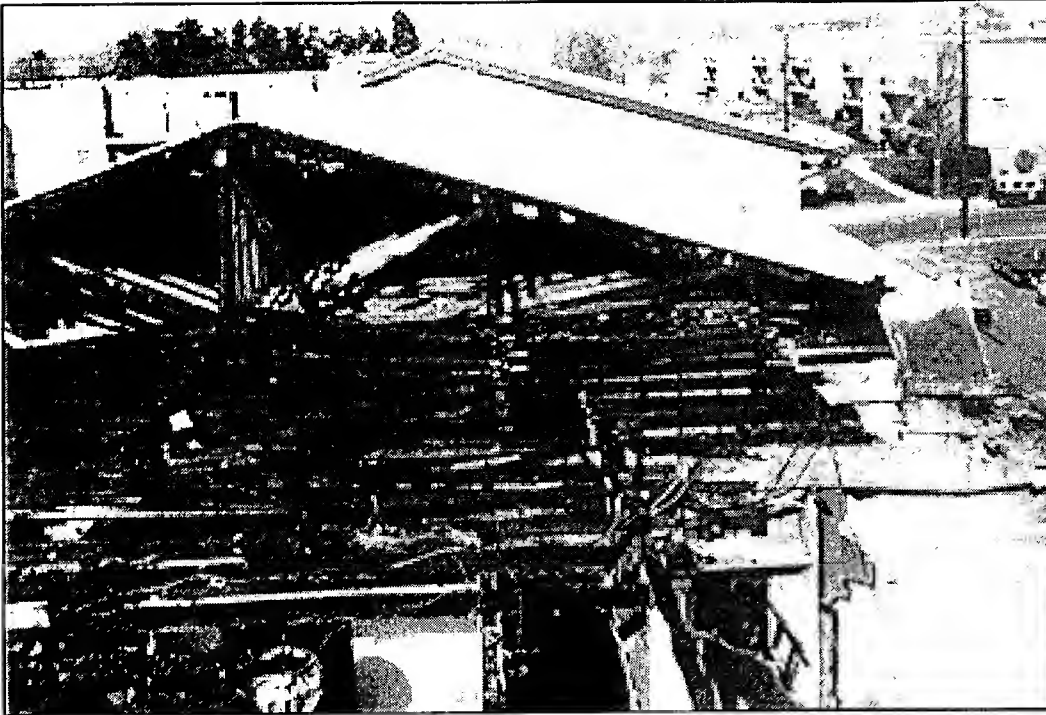


Photo 5: Collapsed roof trusses over an apartment building.
Credit: Francis Brannigan, used with permission

Fire Size-up

The incident commander, an experienced and trained fire officer, observed exterior conditions during his initial fire scene size-up. Based on these observations and on information being provided by the property owner, the incident commander came to the conclusion that the fire was in the area normally occupied somewhere in the store.

Independent of the incident commander's assessment, the Engine 1 officer and one of the Medic 1 fire fighters observed conditions at the fire building and also concluded that the fire was somewhere in the store. Like the incident commander, the officer and the Medic 1 fire fighter both had years of experience and had extensive training in fire suppression operations. None of the officers and fire fighters recognized or anticipated that the fire had spread in the combustibile concealed space before their arrival, nor did they realize that the fire in the combustibile concealed space was growing rapidly while they made preparations for their initial entry. Because all interviewed fire fighters believed that fire was in the occupied space, the strategy of an interior attack appeared to be reasonable for the location and type of fire, and they implemented their fire attack plan. Unfortunately, the fire was not confined to the area where the fire fighters thought it was.

Fire officers and fire fighters missed a second critical detail during their initial size-up. No one on the fireground realized that the roof was constructed with 60-ft (18-m) long, lightweight wood trusses. The Branford Fire Department did not have a pre-fire plan for this building and they did not perform fire prevention inspection of the facility. As a result, responding fire fighters did not have any information regarding the building's construction. Even though the incident commander, En-

engine 1 officer, and Medic 1 fire fighter had received training regarding building construction, the officers did not evaluate the construction beyond noticing that part of the building was wood frame and part of the building had masonry block walls. No one considered what structural components were likely to be supporting the roof over the wide span between the exterior walls. During post-fire interviews, the two officers and a fire fighter stated that before this fire they were aware of trusses being associated with building collapses in other building fires. The fire fighter noted that earlier on the day of the fire, he and other fire fighters had discussed the Hackensack, New Jersey fire in which five fire fighters died as a result of the collapse of a roof supported by trusses.

The Branford Fire Department SOP, *Safety Procedures, Fire Ground Safety*, provided a discussion of structural collapse and within that discussion provided the warning “BEWARE OF TRUSS ROOFS!” The same SOP also provided the following comments about structural collapse:

Structures have been known to collapse without warning but usually there are signs which may tip off the alert Fire Officer. Action might be taken to avert any imminent hazard.

Tell-Tale Signs:

- Cracks in exterior walls.
- Bulges in exterior walls.
- Sounds of structural movement - creaking, groaning, snapping, etc.
- Smoke or water leaking through walls.
- Flexible movement of any floor or roof where fire fighters walk.
- Interior or exterior bearing walls or columns - leaning, twisting or flexing.
- Sagging or otherwise distorted roof lines.

None of these tell-tale signs was noted by fire officers before the collapse occurred. Similarly, there were no external indicators, other than the width of the building, that the roof had been constructed with trusses. The absence of external indicators did not alert the fire officers and fire fighters to the impending danger. During their early size-up activities, they did not conclude that there was an imminent risk of structural collapse.

Pre-fire plans, observations made outside of the building, and observations made inside the building can help fire officers to realize that a building may be constructed with wood trusses. Of these, only “observations made outside of the building” could have provided useful information in this fire scenario. The Branford Fire Department did not have pre-fire plans of this building so fire officers had no documented construction details. Interior observations might have revealed that there were wood trusses if fire fighters had used hand tools to pull down a section of the ceil-

ing. But, even this method would likely have been unsuccessful because the ceiling in the showroom was approximately 10 ft to 12 ft (3.0 m to 3.6 m) above the floor and the smoke was about 3 ft (1.0 m) above the floor. Therefore, it is unlikely the fire fighters would have been able to see the trusses in the concealed space if they had made a hole in the ceiling. Observations made outside of the building could have hinted toward the potential for trusses. Specifically, had fire officers recognized the wide design of the building as an important construction detail, they could have speculated on what kind of structural members were supporting the roof over such a wide span. The logical answers would be that there was the potential for truss construction. It would then be up to the incident commander to determine how he might factor that information into his attack plan.

Another means that fire fighters could have used to determine the roof construction was to open a ventilation hole in the roof. Had this been accomplished the fire fighters would have immediately know that the fire was concealed space below the roof as well as determining that the roof was constructed with trusses. The incident commander stated that he did not have crews open the roof because he had limited resources and personnel available during the early stages of their fireground activities. He initially used the available fire fighters for other tasks early in the fire.

Incident Command

An incident management system provides the means for effective and proper management of fire and other incidents. The system gives the incident commander tools to manage the incident such as span of control, delegation, an incident action plan, defined strategic goals, identified tactical objectives, and most importantly, a specific safety focus for personnel working on scene.

The Branford fire officers and fire fighters who rode the first few apparatus to the scene generally followed the Branford Fire Department's SOPs regarding incident command. The first unit to arrive, Medic 1, initially assumed command and provided the dispatch center with preliminary information about the building and their observations. Once the Medic 1 crew saw Engine 1 approaching, they transferred command and the shift commander on that vehicle accepted command. The incident commander performed a more detailed size-up survey of the building and provided responding equipment with operational instructions. During these initial stages, the incident commander knew which companies were operating at the scene and had a good understanding of their operations. Similarly, the dispatch center and the fire fighters on the fireground clearly knew who the incident commander was.

As the number of fire department members arriving on the fireground increased, the level of control decreased. Fire fighters did not have a staging area where they could report and be organized into cohesive crews. Early in the fire, the incident commander attempted to manage all fireground operations and logistical activities outside of the building. He did not assign staging and sector officers. The incident commander commented that, in retrospect, the fireground operations were expand-

ing much more rapidly than he realized at the time. His ability to manage both interior and exterior fireground activities decreased as more fire companies and individual fire fighters arrived on the scene due to the increasing demands upon him. In addition, arriving fire officers and fire fighters who contacted the incident commander in order to get assignments created many distractions for the incident commander.

From the early moments in the fireground operations some fire officers and fighters took it upon themselves to initiate and perform activities that appeared to the individuals to be appropriate. However, some of the activities that were performed did not correspond with the incident commander's plans. An example was the victim joining the attack crews without the full understanding of the interior officer and without the knowledge of the incident commander. Another example is the fire officers who felt that there was no operational plan after the collapse and decided to initiate interior rescue operations without the knowledge of the incident commander. Although the freelanced operations were done with good intentions, this reduced the control that the incident commander and other command officers had over fireground activities and potentially increased the risk to the fire fighters operating inside the building.

Accountability

Accountability is a key component of any incident management system. An accountability system is used to track personnel on scene, both by function and location. This system provides a built-in safety factor for the incident commander during the course of operations. There are many variations on accountability systems, but the fact remains that some type of accountability must be used and personnel must be trained in its use.

The victim put his identification tag on Engine 1. This act revealed that the victim may have believed that his identification tag was intended to be used for accountability. Despite this belief, the Branford Fire Department was operating at the carpet store fire without an effective personnel accountability system. As a result of this deficiency, the incident commander did not initially realize that the victim remained in the building even after the other six fire fighters escaped.

None of the officers who remained on the outside of the building were assigned to account for personnel even though, at least one, volunteer deputy chief was at the front when the attack crews entered the building. This officer observed activities but did not note the number of fire fighters who were members of the attack crews. After the collapse, the deputy chief did not discuss his observations with the incident commander.

Due to the lack of an effective accountability system and the lack of information gathered by such a system, the incident commander could not readily determine who had been in the building after he began to suspect that a fire fighter was possibly missing.

Communications

The lack of effective radio communications detracted from the operation in several ways. During the initial stages of the fire, radio communications from other communities were intermixed with the Branford Fire Department radio transmissions, causing a slight delay in some transmissions that were relevant to the carpet store fire. This problem was eliminated when the dispatch center disabled the low-band frequency. The Branford Fire Department was not operating with a channel dedicated to fireground transmissions. As a result, the transmission of dispatch and other nonemergency related information caused delays, or bled over transmissions directly related to fireground operations. On the fireground, some fire fighters did not yield to priority messages and many messages were unintelligible due to poor radio communications techniques on the part of the person attempting to make the transmission. None of the problems directly contributed to the outcome of this fire, but all detracted from the efficiency of fireground operations as its complexity increased.

On other hand, the failure to communicate information up through the chain of command caused the incident commander to miss a potentially important observation. A fire fighter observed a glow in the gable vent which hinted toward a fire in the attic space at a time when fire fighters were preparing to enter the building. This information was not communicated to the incident commander. As a result, the incident commander, who had not seen the glow, did not consider that detail in his initial assessment of the fire.

Similarly, interpersonal communications had a direct effect on the outcome. For example, a missed communication occurred between the interior officer and the victim. When the two spoke, the victim understood that he was now part of the interior attack crew. However, the interior officer did not, apparently, alter his perception of the number of fire fighters that were going to enter the building. After escaping from the building and while enduring the stress of knowing that some one was still in the building, the interior officer did not immediately recall the brief contact that he had with the victim and that the victim had become part of the interior crews. Though of less importance, fire department members who were interviewed recalled many examples of interpersonal communications that were misunderstood or went unheeded. These were a few examples of poor communications between individuals that caused information to be lost and contributed to the outcome of the fire.

Code Analysis

In the interest of comparing conditions and other details regarding this incident with current national consensus codes, NFPA 13, *Standard for the Installation of Sprinkler Systems*, 1996 edition; NFPA 1001, *Standard for Fire Fighter Professional Qualifications*, 1992 edition; NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*, 1992 edition; and NFPA 1561, *Standard on Fire Department Incident Management Systems*, 1992 edition were used as the basis for this comparison. It was recognized, however, that these codes were not part of legal requirements adopted by the City of Branford. The following discussion concerns

requirements that have particular relevance to this fire. It is not intended to be a complete description of all parts of the codes that could be relevant to this incident.

NFPA 13, *Standard for the Installation of Sprinkler Systems*

While an automatic sprinkler system was not required by the State of Connecticut Building Codes or the *Life Safety Code*, an automatic sprinkler system would have helped to reduce the severity of the fire and ultimately the risk to the responding fire fighters. An automatic sprinkler system installed in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*, Paragraph 4-13.1.1 would have required that all combustible concealed spaces enclosed wholly or partially by exposed combustible construction be protected by automatic sprinklers. Sprinklers within the concealed wood truss area would have helped to reduce the intensity and severity of the fire involving the wood truss roof assembly in the Branford carpet store. More importantly, a sprinkler system protecting the occupied areas of the building would have probably controlled the fire and prevented it from entering the combustible concealed space.

NFPA 1001, *Standard for Fire Fighter Professional Qualifications*

NFPA recognizes that the skill and knowledge of fire fighters will contribute to effective and safe fireground operations. NFPA 1001 identifies the performance requirements necessary to perform the duties of a fire fighter. It specifically identifies the minimum requirements for fire fighter candidates and for two levels of advanced performance.

The training as required by NFPA 1001 provides fire fighters with knowledge and experience that fire officers and fire fighters can use to help protect themselves while working in environments and situations that can potentially cause them harm. For example, the interior officer had learned many survival techniques in his training and through his experience. Some of the survival techniques that he attempted to apply, and, in many instances successfully, included:

- Remembering to try to follow the hoseline out of the building when one needs to quickly leave the building
- Recognizing that fire above his head posed an immediate and severe threat to everyone in the building
- Communicating his evacuation plan to the other fire fighters in his area
- Methodically moving through the building when visibility was zero
- Remembering how personnel doors are typically locked and systematically checking for those locks until he was able to open the door.

Fire officers and fire fighters may also use information regarding building construction as a tool to protect themselves. The training a fire fighter receives can provide them with a general understanding of building construction types and how each performs under exposure to fire. When these concepts are combined with specific knowledge about a particular building's construction as might be obtained by a pre-fire inspection, fire officers and fire fighters are better able to assess potential risks, anticipate possible threats to their safety, and select effective fireground tactics for a particular incident.

Among the many requirements of NFPA 1001, Section 4-23 requires Fire Fighter II candidates to be familiar with building construction. The candidates are required to identify the general fire behavior involving the five types of construction, i.e., wood frame, ordinary, heavy timber, noncombustible and fire resistant. The candidates are also required to know how the spread of fire can affect the safety of the building, occupants and fire fighters. Section 1001: 4-23 specifically requires Fire Fighter II candidates to describe at least three hazards of truss and lightweight construction and five indicators of building collapse. The performance requirements of Section 4-23 call for fire fighters to learn how to recognize construction types and the risks associated with each. With this information, the fire fighter might be able to better identify fireground situations that could place him at risk, and fire officers could select fireground tactics that would minimize the known risks.

NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*

- Risk Management During Emergency Operations

Paragraph 6-2.1 requires an incident commander to integrate risk management into the regular functions of incident command. The incident commander is also required to evaluate the risk to members with respect to the purpose and potential results of their actions in each situation. In situations where the risk to fire department members is excessive, the paragraph requires that activities be limited to defensive operations (see 6-2.1.2).

The incident commander is not the only fire department member required to use the risk management concept. Paragraph 6-2.2 requires supervisory personnel at all levels to employ risk management principles to define the limits of acceptable and unacceptable positions and functions for all members at the incident scene.

Paragraph 6-2.1.1 requires fireground risk management to be based on the following principles:

- (a) Activities that present a significant risk to the safety of members shall be limited to situations where there is a potential to save endangered lives.
- (b) Activities that are routinely employed to protect property shall be rec-

ognized as inherent risks to the safety of members, and actions shall be taken to reduce or avoid these risks.

- (c) No risk to the safety of members shall be acceptable when there is no possibility to save lives or property.

The Branford Fire Department also recognized that the risk to fire fighters must be managed on the fireground. The fire department's SOP, *Safety Procedures, Fireground Safety*, instructed members to use caution when personnel are operating in positions that can severely affect their safety and survival and listed positions that would require extra caution. One of the listed positions was "operating under involved roof structures." The SOP also included the following commentary:

The safety of fire fighting personnel represents the major reason for an effective and well-timed offensive/defensive decision and the associated write-off by Command. When the rescue of savable victims has been completed, Command must ask:

"IS THE RISK TO MY PERSONNEL WORTH THE PROPERTY I CAN SAVE?"

Though the Branford Fire Department may not have used the same terminology as in NFPA 1500, the fire department's SOP 205.0 appeared to be their approach for incorporating risk management concepts into fireground operations.

Accountability

Section 6-3 of NFPA 1500 requires all fire departments to establish written standard operating procedures for a personnel accountability system in accordance with Section 4-3 of NFPA 1561, *Standard on Fire Department Incident Management System*. The accountability system is required to provide for the tracking and inventory of all members operating at an emergency incident. The Branford Fire Department had not developed a formal system, written procedure, or any type of policy for accounting for personnel on the fireground.

In addition to requiring that a personnel accountability system be used, Section 6-3 provides many requirements affecting the application of that system. For example, Section 6-3 requires all members operating at an emergency incident to actively participate in the accountability system. Responsibility for overall personnel accountability is placed clearly on the incident commander. Additionally, it requires members to follow personnel accountability system procedures and to use the personnel accountability system at all incidents. Since the Branford Fire Department did not have an accountability system, fire officers and fire fighters at the scene did not perform in a manner consistent with these NFPA requirements.

Following the collapse of the roof assembly, there was a high level of confusion and stress on the fireground. Initially, the incident commander did not realize that

a fire fighter was missing because he had thought that only six fire fighters had entered the building, and he could account for all of them after the collapse. Since conditions in the building deteriorated rapidly after the fire fighters were trapped, it is unclear whether an earlier accounting of the fire fighters would have changed the outcome of the fire in terms of the survival of the last fire fighter. However, an accounting of fire fighters immediately following the roof collapse would have helped to reduce the confusion regarding who had been in the building.

Members Operating at Emergency Incidents

Section 6-4 of NFPA 1500 requires a fire department to provide an adequate number of personnel to safely conduct emergency scene operations. This section also provides the many requirements which are intended to reduce the risk to fire fighters. Those requirements include the following:

- Inexperienced members must work under the supervision of more experienced officers or members (6-4.2).
- Members operating in hazardous areas at emergency incidents shall operate in teams of two or more, and team members shall be in communication with each other (6-4.3).
- In the initial stages of an incident where only one team is operating in the hazardous area, at least one additional member shall be assigned to stand by outside of the hazardous area where the team is operating (6-4.4).
- The standby member may perform other duties outside of the hazardous area, such as apparatus operator or incident commander (6-4.4.2).
- The standby member will be provided with full, protective clothing, protective equipment, and SCBA and will be permitted to rescue or provide for the rescue of the members of the one team that is operating if the need arises (6-4.4.3).
- Once a second team is assigned or operating in the hazardous area, at least one rapid intervention crew shall be required (6-4.4.4).

Except for providing the rapid intervention crew, the Branford fire fighters' activities were, for the most part, consistent with these requirements.

Rapid Intervention for Rescue of Members.

Section 6-5 of NFPA 1500 designates the requirements for rapid intervention crews. Those requirements include the following:

- Fire departments will provide a rapid intervention crew for the rescue

of members operating at emergency incident, if the need arises (6-5.1).

- The crew will consist of at least two fully equipped members (6-5.2).
- The composition and structure of crews can be flexible and based on the type of incident and the size and complexity of operations. The incident commander will provide at least one crew commensurate with the situation and the risks to fire fighters (6-5.3).
- In the early stages of an incident, the crew(s) will be either members designated as rapid intervention crew(s) or members performing other functions but ready to redeploy to perform rapid intervention crew functions (6-5.4).

The Branford Fire Department did not have a standard operating procedure requiring the use of a rapid intervention crew. Such a departmental procedure would have highlighted the importance of such a crew to incident commanders who are managing limited resources on a fireground. More importantly, a standard operating procedure would have required the use of such teams.

During this fire, the incident commander had considered assigning one of the initial crews to that task, but used the crew for ventilation instead due to limited resources. Following this initial consideration, no crew was assigned to the rapid intervention function. When such a crew was needed after the collapse, the incident commander was not able to quickly assemble one due to the confusion that arose on the fireground. Since a rapid intervention crew was not formally assigned, this aspect of the fireground operation was not consistent with Section 6-5 of NFPA 1500.

NFPA 1561, *Standard on Fire Department Incident Management System*

Like NFPA 1500, NFPA 1561, *Standard on Fire Department Incident Management System*, has requirements for personnel accountability. These requirements, once again, call for a fire department to adopt and routinely use a system that will provide for a rapid accounting of all personnel at the incident scene (see 2-6.2). As discussed earlier in the report, this type of system did not exist in the Branford Fire Department and was not used during the carpet store fire.

Paragraph 2-6.3 requires that all supervisors maintain a constant awareness of the position and function of all personnel assigned to operate under their supervision. This awareness will serve as the basic means of accountability required for operational safety.

Paragraph 2-6.3 addresses a subtle but significant event that occurred during the Branford fire. The victim was not initially assigned as one of the six members of the interior attack crews. As a result, the interior officer, apparently, did not consciously include the victim into his mental image of the group that he was supervising. The interior officer believed he was supervising five, not six fire fighters when the crews entered

the building. As a result, the interior officer did not immediately recall after the collapse that the victim had been part of his group. Additionally, the incident commander was aware of only six fire fighters entering the building. These events reinforce the importance of having each fire fighter assigned to a specific officer and that an officer accept responsibility for the fire fighters assigned to him or her.

NFPA 1561 requires that an incident management system maintain accountability for the location and function of each company and the personnel responding with each company (see 2-6.3.1). NFPA 1561 also requires that the incident management system account for all personnel who respond to the incident by means other than fire apparatus (see 2-6.3.2).

The Branford Fire Department had no formal method or written procedures regarding personnel accountability. Members of the Branford Fire Department recognized that the incident commander was responsible for fire fighter accountability. However, the means for accomplishing that function was left to the discretion of the incident commander.

During the November 28, 1996 fire, the incident commander knew the individuals who were assigned to the initial attack crews. He also kept track of the arriving companies and expected that fire fighters on these crews would know the other crew members. However, as more fire fighters arrived in personal vehicles, the incident commander's ability to account for all fire fighters and his ability to control the activities of each fire fighter decreased. Freelancing by some fire fighters and fire officers further diminished the incident commander's control of the fireground activities and contributed to the inability to account for all fire fighters after the collapse of the roof.

Paragraph 2-6.5 requires a standard operating guideline to evacuate personnel from an area where an imminent hazard condition is found to exist and to account for their safety. The Branford Fire Department had in place an SOP regarding emergency evacuation of members and had trained members with respect to that procedure. When the need arose quickly to evacuate the building, fire vehicle air horns were used to provide a signal. Fire fighters inside heard that signal. The evacuation signal reinforced the radio transmissions ordering the fire fighters out of the building.

NFPA 1561 requires that a communications system provide a method to give priority to the transmission of emergency messages. The Branford Fire Department had two methods to achieve this goal. First, the fire department established two radio signals that would bring immediate attention to an imminent hazard. One of these signals – Signal One – was used and clearly understood by fire fighters and the Branford Fire Department dispatch center. In response to this signal, fire fighters inside the building immediately began to evacuate. The second method was the emergency signal button on the portable radio. The interior officer had a radio equipped with this feature but he did not use it. The officer was not sure why he did not use the button. However, he did state that the small recessed button was almost impossible to use with fire fighting gloves on.

VI. DISCUSSION

The Branford fire is only one of many incidents involving wood trusses that has resulted in fire fighter fatalities. NFPA statistics show that from 1977 through 1995, 28 fire fighters were killed in 15 incidents where wood truss roofs failed while the fire fighters worked on or below them. The NFPA Fire Investigations Department has prepared reports regarding the March 18, 1996, fire and collapse of wood trusses in a Chesapeake, Virginia, automobile parts store that claimed the lives of two fire fighters; the July 1, 1988, fire and collapse of wood trusses in a Hackensack, New Jersey, automobile dealership that claimed the lives of five fire fighters; and the August 2, 1978, fire and collapse of wood trusses in a New York, New York, supermarket that claimed the lives of six fire fighters. The Hackensack and New York fatalities were included in the 30 fire fighter fatalities. The NFPA statistics also showed that one fire fighter was killed in the period from 1977 through 1995 when a steel truss roof collapsed.

One of the most important steps that fire fighters can take to improve their chances of survival during fire fighting operations in buildings constructed with lightweight wood trusses is to improve their general knowledge regarding truss construction. Fire fighters should develop a basic knowledge of why trusses are used in buildings and how to identify buildings that could be constructed with trusses. Fire fighters should also clearly understand how truss construction can affect their fire fighting operation and their safety.

Fire fighters' knowledge regarding truss construction should be very similar to that which many have regarding balloon-frame construction. Through experience and training, fire fighters have learned how to identify buildings that are likely to be of balloon-frame construction, what effect that type of construction can have on fire spread and what fire fighting tactics may be needed to safely suppress the fire.

Pre-fire inspections are an excellent opportunity for fire fighters to gather specific building construction information of buildings and to identify those constructed with components that could place fire fighters at risk during fire suppression operations. Once the buildings have been identified, fire fighters could then, at the very least, make appropriate notations in the building's pre-fire plan.

Another means for increasing fire fighters' awareness of truss construction is the use of placards on buildings. Following the loss of five fire fighters during the collapse of bowstring trusses in Hackensack, New Jersey, on July 1, 1988, the state of New Jersey adopted a law requiring all buildings that are constructed with trusses to be marked with a placard. The placard can bring the presence of a truss to the attention of responding fire fighters. A recent fire in New Jersey that was reported to the NFPA showed this system appears to be working. Fire fighters in one New Jersey community were made aware of the presence of trusses by a truss placard that had been placed on the outside of the building. Once aware of the trusses, the incident commander immediately began accounting for them in his fire attack strategy. The use of placards is only one method that will help fire fighters identify build-

ings with construction or other features that could place the fire fighters at risk during fire suppression operations.

During the November 28, 1996, fire in Branford, Connecticut, every fire fighter who entered the building as part of the interior fire suppression operation was at risk of being trapped by a collapse of the roof. When the roof did collapse, all seven fire fighters faced the immediate and real threat of being injured or killed, and the difference between events leading to survival and nonsurvival was very small. Automatic suppression of the fire before it involved the roof trusses would have eliminated the risk to fire fighters, and recognition of the trusses by fire officers might have helped them to formulate a fire attack plan that would have minimized the risk to fire attack crews.

The ability for officers who were outside of the building to account for the fire fighters working inside and many other fireground activities did not increase or decrease the risk to fire fighters once they entered the building. However, these factors did affect the fire fighters' abilities to determine that everyone did not escape and the effectiveness of fireground operations after the collapse.

On the basis of its investigation and analysis, the NFPA determined that all fire fighters who entered the building were at risk of being trapped and killed. The following significant factors directly contributed to the danger that threatened everyone in the building and to the loss of the Branford fire fighter:

- The lack of automatic sprinkler protection
- The lack of pre-fire plan or other information that would have made fire officers aware that the roof of the store was constructed with lightweight wood trusses.
- Ineffective communication during verbal exchanges on the fireground.

In addition, the following factors detracted from potential for rescuing the fire fighters who were trapped in the building and decreased the efficiency of fireground operations:

- Ineffective use of an incident management system and no formal fire fighter accountability system
- The absence of a Rapid Intervention Crew (RIC) and the absence of a fire department standard operating procedure for a RIC
- The lack of a dedicated fireground channel
- Ineffective communication while using radios.

VII. ADDITIONAL INFORMATION

Since 1978, NFPA has prepared three fire investigation reports following NFPA investigations of other incidents that caused the death of fire fighters as a result of wood roof truss collapses. The following is a list of those reports and articles:

- Fire Investigation Report: Automobile Parts Store, Two Fire Fighter Fatalities, Chesapeake, Virginia, March 18, 1996.
- Summary Fire Investigation Report: Five Fire Fighter Fatalities, Hackensack, New Jersey, July 1, 1988.
- Investigation Report: Six Fire Fighter Fatalities, 2892 Ocean Avenue, Brooklyn, New York, August 2, 1978.

The NFPA also published the article “Preliminary Report: Double Tragedy in Gift Shop Fire,” in the June 1989 issue of *Fire Command*. This article discussed the fire in Orange County, Florida, that killed two fire fighters in a wood truss roof collapse.

In 1988 and 1989, *NFPA Journal* published the following two articles discussing the performance of wood trusses. These articles provided two perspectives on the subject:

- Schaffer, Erwin L., P.E., Ph.D., “How Well Do Wood Trusses Really Perform During a Fire?,” March 1988.
- Routley, Gordon J., “How Wood Trusses Perform During a Real Fire,” January 1989.

VIII. CODE SECTIONS

The following is the complete text of sections and paragraphs that are relevant to this incident from NFPA 13, *Standard for the Installation of Sprinkler Systems*, 1996 edition; NFPA 1001, *Standard for Fire Fighter Professional Qualifications*, 1992 edition; NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*, 1992 edition; and NFPA 1561, *Standard on Fire Department Incident Management Systems*, 1992 edition:

NFPA 13, Standard for the Installation of Sprinkler Systems

4-13.1 Concealed Spaces.

13: 4-13.1.1* All concealed spaces enclosed wholly or partly by exposed combustible construction shall be protected by sprinklers.

Exception No. 1: Concealed spaces formed by studs or joists with less than 6 in. (152 mm) between the inside or near edges of the studs or joists. (See Figure 4-6.4.1.4.)

Exception No. 2: Concealed spaces formed by bar joists with less than 6 in. (152 mm) between the roof or floor deck and ceiling.

Exception No. 3: Concealed spaces formed by ceilings attached directly to or within 6 in. (152 mm) of wood joist construction.

Exception No. 4: Concealed spaces formed by ceilings attached directly to the underside of composite wood joist construction, provided the joist channels are firestopped into volumes each not exceeding 160 ft³ (4.53 m³) using materials equivalent to the web construction.

Exception No. 5: Concealed spaces entirely filled with noncombustible insulation.

Exception No. 6: Concealed spaces within wood joist construction and composite wood joist construction having noncombustible insulation filling the space from the ceiling up to the bottom edge of the joist of the roof or floor deck, provided that in composite wood joist construction the joist channels are firestopped into volumes each not exceeding 160 ft³ (4.53 m³). The joists shall be firestopped to the full depth of the joist with material equivalent to the web construction.

Exception No. 7: Concealed spaces over isolated small rooms not exceeding 55 ft² (4.6 m²) in area.

Exception No. 8: Where rigid materials are used and the exposed surfaces have a flame spread rating of 25 or less and the materials have been demonstrated not to

propagate fire in the form in which they are installed in the space.

Exception No. 9: Concealed spaces in which the exposed materials are constructed entirely of fire-retardant treated wood as defined by NFPA 703, Standard for Fire Retardant Impregnated Wood and Fire Retardant Coatings for Building Materials.

Exception No. 10: Noncombustible concealed spaces having exposed combustible insulation where the heat content of the facing and substrate of the insulation material does not exceed 1000 Btu per ft² (11 356 kJ/m²).

13: 4-13.1.2 Sprinklers in concealed spaces having no access for storage or other use shall be installed in accordance with the requirements for Light Hazard Occupancy.

13: 4-13.1.3 Where heat-producing devices such as furnaces or process equipment are located in the joist channels above a ceiling attached directly to the underside of composite wood joist construction that would not otherwise require sprinkler protection of the spaces, the joist channel containing the heat-producing devices shall be sprinklered by installing sprinklers in each joist channel, on each side, adjacent to the heat-producing device.

NFPA 1001, Standard for Fire Fighter Professional Qualifications

1001: 4-23 Building Construction.

1001: 4-23.1 Describe the basic structural characteristics of the following types of building construction:

- (a) Wood frame
- (b) Ordinary
- (c) Heavy timber
- (d) Noncombustible
- (e) Fire resistant.

1001: 4-23.2 Identify the general fire behavior expected with each type of building construction, including the spread of fire and the safety of the building, occupants, and fire fighters.

1001: 4-23.3 Describe at least 3 hazards associated with truss and lightweight construction.

1001: 4-23.4 Identify dangerous building conditions created by fire and fire suppression activities.

1001: 4-23.5 Identify 5 indicators of building collapse.

1001: 4-23.6 Describe the effects of fire and fire suppression activities on the following building materials:

- (a) Wood
- (b) Masonry (brick, block, stone)
- (c) Cast iron
- (d) Steel
- (e) Reinforced concrete
- (f) Gypsum wallboard
- (g) Glass
- (h) Plaster on lath.

1001: 4-23.7 Define the following terms as they relate to building construction:

- (a) Veneer wall (exterior)
- (b) Party wall
- (c) Fire wall
- (d) Partition wall
- (e) Cantilever or unsupported wall
- (f) Load bearing.

NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*, 1992 edition.

1500: 6-2 Risk Management During Emergency Operations.

1500: 6-2.1* The incident commander shall integrate risk management into the regular functions of incident command.

1500: A-6-2.1 The incident commander has an ultimate responsibility for the safety of all fire department members operating at an incident and for any and all other persons whose safety is affected by fire department operations. Risk management provides a basis for:

- (a) Standard evaluation of the situation
- (b) Strategic decision-making
- (c) Tactical planning
- (d) Plan evaluation and revision
- (e) Operational command and control.

1500: 6-2.1.1* The concept of risk management shall be utilized on the basis of the following principles:

- (a) Activities that present a significant risk to the safety of members shall

- be limited to situations where there is a potential to save endangered lives.
- (b) Activities that are routinely employed to protect property shall be recognized as inherent risks to the safety of members, and actions shall be taken to reduce or avoid these risks.
- (c) No risk to the safety of members shall be acceptable when there is no possibility to save lives or property.

1500: A-6-2.1.1 The risk to fire department members is the most important factor considered by the incident commander in determining the strategy that will be employed in each situation. The management of risk levels involves all of the following factors:

- (a) Routine evaluation of risk in all situations
- (b) Well-defined strategic options
- (c) Standard operating procedures
- (d) Effective training
- (e) Full protective clothing and equipment
- (f) Effective incident management and communications
- (g) Safety procedures and safety officers
- (h) Back-up crews for rapid intervention
- (i) Adequate resources
- (j) Rest and rehabilitation
- (k) Regular reevaluation of conditions
- (l) Pessimistic evaluation of changing conditions
- (m) Experience based on previous incidents and critiques.

1500: 6-2.1.2* The incident commander shall evaluate the risk to members with respect to the purpose and potential results of their actions in each situation. In situations where the risk to fire department members is excessive, as defined by 6-2.1.1 of this section, activities shall be limited to defensive operations.

1500: A-6-2.1.2 The acceptable level of risk is directly related to the potential to save lives or property. Where there is no potential to save lives, the risk to fire department members must be evaluated in proportion to the ability to save property of value. When there is no ability to save lives or property, there is no justification to expose fire department members to any avoidable risk, and defensive fire suppression operations are the appropriate strategy.

1500: 6-2.2 Risk management principles shall be routinely employed by supervisory personnel at all levels of the incident management system to define the limits of acceptable and unacceptable positions and functions for all members at the incident scene.

1500: 6-2.3* At significant incidents and special operations incidents, the incident commander shall assign qualified personnel with the specific authority and responsibility to evaluate hazards and provide direction with respect to the safety of operations.

1500: A-6-2.3 A safety sector should be established at all major incidents and at any high-risk incidents. The safety sector would normally be assigned to operate under the fire department safety officer or an assigned officer with this responsibility. If the designated safety officer is not available and the need for a safety sector is evident, the incident commander should assign one or more members to assume this responsibility on a temporary basis. Depending on the specific situation, this assignment could require one or more members. All members should be familiar with the basic duties and responsibilities of a safety sector.

1500: 6-3 Accountability.

1500: 6-3.1 The fire department shall establish written standard operating procedures for a personnel accountability system in accordance with Section 4-3 of NFPA 1561, *Standard on Fire Department Incident Management System*, and that provides for the tracking and inventory of all members operating at an emergency incident.

1500: 6-3.1.1 The system shall consider local conditions and characteristics in establishing the requirements of the personnel accountability system.

1500: 6-3.2 It shall be the responsibility of all members operating at an emergency incident to actively participate in the personnel accountability system.

1500: 6-3.3 The incident commander shall be responsible for overall personnel accountability for the incident. The incident commander shall initiate an accountability and inventory worksheet at the very beginning of operations and shall maintain that system throughout operations.

1500: 6-3.3.1 The incident commander shall maintain an awareness of the location and function of all companies and sectors.

1500: 6-3.3.2 Sector officers shall directly supervise and account for the companies operating in that sector.

1500: 6-3.3.3 Company officers shall maintain an ongoing awareness of the location and condition of all company members.

1500: 6-3.3.4 Where assigned as a company, members shall be responsible to remain under the supervision of their assigned company officer.

1500: 6-3.3.5 Members shall be responsible to follow personnel accountability system procedures.

1500: 6-3.4 The personnel accountability system shall be used at all incidents.

1500: 6-3.5 The fire department shall develop the system components required to make the personnel accountability system effective.

1500: 6-3.6 The standard operating procedures shall provide the use of additional accountability officers based on the size, complexity, or needs of the incident. These accountability officers shall work with the incident commander and sector officers to assist in the ongoing tracking and accountability of members.

1500: 6-4 Members Operating at Emergency Incidents.

1500: 6-4.1 The fire department shall provide an adequate number of personnel to safely conduct emergency scene operations. Operations shall be limited to those that can be safely performed by the personnel available at the scene. No member or members shall commence or perform any fire fighting function or evolution that is not within the established safety criteria of the organizational statement as specified in 2-1.2 of this standard.

1500: 6-4.2 When inexperienced members are working at an incident, direct supervision shall be provided by more experienced officers or members. This requirement shall not reduce the training requirements contained in Chapter 3 of this standard.

1500: 6-4.3 Members operating in hazardous areas at emergency incidents shall operate in teams of two or more. Team members operating in hazardous areas shall be in communication with each other through visual, audible, physical, safety guide rope, or electronic means, or by other means in order to coordinate their activities. Team members shall be in close proximity to each other to provide assistance in case of emergency.

1500: 6-4.4 In the initial stages of an incident where only one team is operating in the hazardous area, at least one additional member shall be assigned to stand by outside of the hazardous area where the team is operating. This standby member shall be responsible for maintaining a constant awareness of the number and identity of members operating in the hazardous area, their location and function, and time of entry. The standby member shall remain in radio, visual, voice, or signal line communications with the team.

1500: 6-4.4.1 The “initial stages” of an incident shall encompass the tasks undertaken by the first arriving company with only one team assigned or operating in the hazardous area.

1500: 6-4.4.2 The standby member shall be permitted to perform other duties outside of the hazardous area, such as apparatus operator, incident commander, or technician or aide, provided constant communication is maintained between the standby member and the members of the team.

1500: 6-4.4.3 The standby member shall be provided with at least the appropriate full protective clothing, protective equipment, and SCBA as required in Chapter 5 of this standard. The standby member shall be permitted to rescue or provide for the rescue of the members of the one team that is operating if the need arises. If

such a rescue need arises, the standby member shall communicate the situation to the communications center and additional response shall be dispatched if not already underway.

1500: 6-4.4.4 Once a second team is assigned or operating in the hazardous area, the incident shall no longer be considered in the “initial stage,” and at least one rapid intervention crew shall be required.

1500: 6-4.5 When members are performing special operations, the highest level of emergency medical care shall be standing by at the scene with medical equipment and transportation capabilities. Basic life support shall be the minimum level of emergency medical care.

1500: 6-4.5.1 All emergency medical personnel who provide emergency medical care and medical monitoring at hazardous material incidents shall meet the minimum requirements of NFPA 473, *Standard for Competencies for EMS Personnel Responding to Hazardous Materials Incidents*.

1500: 6-4.5.2 At all other emergency operations, the incident commander shall evaluate the risk to the members operating at the scene and, if necessary, request that at least basic life support personnel and patient transportation be available.

1500: 6-4.6 When members are operating from aerial devices, they shall be secured to the aerial device by an approved safety harness that complies with the requirements of 5-8.1.1 of this standard.

1500: 6-4.7 When members are operating at an emergency incident and their assignment places them in potential conflict with motor vehicle traffic, they shall wear a garment with fluorescent retroreflective material.

1500: 6-4.7.1 Apparatus shall be utilized as a shield from oncoming traffic whenever possible.

1500: 6-4.7.2 When acting as a shield, apparatus warning lights shall remain on, and fluorescent and retroreflective warning devices such as traffic cones, illuminated warning devices such as highway flares, or other appropriate warning devices shall be used to warn oncoming traffic of the emergency operations and the hazards to members operating at the incident.

1500: 6-5 Rapid Intervention for Rescue of Members.

1500: 6-5.1 The fire department shall provide personnel for the rescue of members operating at emergency incidents if the need arises.

1500: 6-5.2 A rapid intervention crew shall consist of at least two members and shall be available for rescue of a member or a team if the need arises. Rapid intervention crews shall be fully equipped with the appropriate protective clothing, pro-

protective equipment, SCBA, and any specialized rescue equipment that might be needed given the specifics of the operation underway.

1500: 6-5.3 The composition and structure of rapid intervention crews shall be permitted to be flexible based on the type of incident and the size and complexity of operations. The incident commander shall evaluate the situation and the risks to operating teams, and shall provide one or more rapid intervention crews commensurate with the needs of the situation.

1500: 6-5.4 In the early stages of an incident, the rapid intervention crew(s) shall be either:

- (a) On-scene members designated and dedicated as rapid intervention crew(s).
- (b) On-scene members performing other functions but ready to redeploy to perform rapid intervention crew functions.

1500: 6-5.5 As the incident expands in size or complexity, the rapid intervention crews shall be either:

- (a) On-scene members designated and dedicated as rapid intervention crews.
- (b) On-scene company or companies either in a staging area, or designated and dedicated as rapid intervention crews.

1500: 6-5.6 Whenever members are operating in positions or performing functions that include special operations or would subject them to immediate danger of injury in the event of equipment failure or other sudden event, at least one rapid intervention crew shall be standing by with equipment to provide assistance or rescue.

NFPA 1561, *Standard on Fire Department Incident Management Systems*, 1995 edition.

1561: 2-2.4* The communications system shall provide a standard method to give priority to the transmission of emergency messages and notification of imminent hazards to all levels of the incident command structure over that of routine communications.

1561: A-2-2.4 The emergency notification system should provide a means to rapidly warn all persons who might be in danger if an imminent hazard is identified or if a change in strategy is made. An emergency message format with distinctive alert tones and definitive instructions should be used to make such notifications.

1561: 2-6 Personnel Accountability.

1561: 2-6.1 The incident management system shall provide for personnel accountability at the incident scene.

1561: 2-6.2 The fire department shall adopt and routinely use a system to maintain accountability for all personnel assigned to the incident. This system shall provide a rapid accounting of all personnel at the incident scene.

1561: 2-6.3 All supervisors shall maintain a constant awareness of the position and function of all personnel assigned to operate under their supervision. This awareness shall serve as the basic means of accountability that shall be required for operational safety.

1561: 2-6.3.1 The incident management system shall maintain accountability for the location and function of each company or unit at the scene of the incident. Personnel who respond to the incident on fire apparatus shall be identified by a system that provides an accurate accounting of those personnel actually responding to the scene with each company or on apparatus.

1561: 2-6.3.2 Personnel who arrive at the scene of the incident by means other than fire apparatus shall be identified by a system that accounts for their presence and their assignment at the incident scene.

1561: 2-6.4 The system shall include a specific means to identify and keep track of personnel entering and leaving hazardous areas, such as confined spaces or areas where special protective equipment is required.

1561: 2-6.5 The incident management system shall include a standard operating guideline to evacuate personnel from an area where an imminent hazard condition is found to exist and to account for their safety. This guidance shall include a method to notify immediately all personnel in the affected area by means of audible warning devices, and by radio signals in accordance with the requirements specified in 2-2.4.

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